THURSDAY, SEPTEMBER 25, 1890.

THE GOLDEN BOUGH.

The Golden Bough: a Study in Comparative Religion. By J. G. Frazer, M.A. In Two Volumes. (London: Macmillan and Co., 1890.)

THE object of this book is to offer a probable explanation of the priesthood of Nemi. The method adopted is to show that such barbarous customs as those associated with that priesthood were also carried on elsewhere; and "if we can detect the motives which led to its institution; if we can prove that these motives have operated widely, perhaps universally, in human society, producing in varied circumstances a variety of institutions specifically different but generically alike; if we can show, lastly, that these very motives, with some of their derivative institutions, were actually at work in classical antiquity; then we may fairly infer that at a remoter age the same motives gave birth to the priesthood of Nemi."

The author, Mr. Frazer, informs us in his preface that he has for some time been preparing a general work on primitive superstition and religion. We are glad to learn from the same source that his studies to this end have been systematized, encouraged, and influenced by Mr. W. Robertson Smith. The book shows from cover to cover how important this influence has been, and how thorough has been the work done; it is a perfect mine of early folk-lore, while the method of arrangement and the way in which the facts are marshalled along the different lines of inquiry, leaves nothing to be desired.

It must be understood, however, that this is not the general work to which we have referred above. It is an *excursus* on a special point, an attempt to solve the difficult problem connected with the hitherto unexplained rule of the Arician priesthood.

Having said thus much on the origin of the book, we may next proceed to remark that in such a case as this criticism pure and simple of the details is almost out of the question. We prefer rather to lay before the readers of NATURE a summary of the various steps employed in the argument, accompanied by references to those points which we have found of special interest.

The priesthood of Nemi is one of the most extraordinary character, and has no parallel in classical antiquity. The sacred grove and sanctuary of Diana Nemorensis, or Diana of the Wood, lay on the northern shore of the lake, right under the steep cliffs on which stands the modern village of Nemi. The lake and grove were sometimes called the lake and grove of Aricia, but the town of Aricia was distant three miles. There grew in this grove a certain tree, around which there might almost always be seen a strange figure prowling. The man carried a drawn sword, and persistently looked about him as if he expected every moment to be set upon by an enemy. He was the priest, and also a murderer; and "the man for whom he looked was sooner or later to murder him and hold the priesthood in his stead. Such was the rule of the sanctuary. A candidate for the priesthood could only succeed to office by slaying the priest; and having slain him he held office till he was himself slain by a stronger or a craftier."

The author begins by stating the few facts and theories bequeathed to us on the subject of the priesthood of Nemi. The first questions that he attempts to answer concern the title of this priest. Why was he called the king of the wood? Why was his office spoken of as a kingdom? To obtain an answer to the first question he has to go into the details of the facts, legends, &c., recorded of primitive man, and to see whether there were such beings as kings of rain, water, fire, &c., to match the Arician king who bore the name of king of the wood. In this search he brings out a wonderful array of interesting facts as regards sympathetic magic, rain making, sunshine making, controlling the wind, fighting the wind, &c.; and § 3, which treats of incarnate gods, is full of examples, "drawn from the beliefs and practices of rude peoples all over the world, which may suffice to prove that the savage, whether European or otherwise, fails to recognize those limitations to his power over nature which seem so obvious to us."

Having found instances of kings of rain, water, and fire, the author next looks for a king of the wood. Since the worship of trees played an important part among the religious ideas of the Aryan race in Europe, a king of the wood ought to be found closely connected with tree worship, and so it happens. Innumerable instances of this form of worship have been got together, showing the way in which trees were looked upon at an early stage of civilization. Men supposed that the trees had souls, that tree spirits could give rain and sun, and that the harvests were dependent on them. "In Sumatra, so soon as a tree is felled, a young tree is planted on the stump; and some betel and a few small coins are also placed on it. Here the purpose is unmistakable. The spirit of the tree is offered a new home in the young tree planted on the stump of the old one, and the offering of betel and money is meant to compensate him for the disturbance he has suffered." The may-pole of to-day is only an emblem of the old form of tree-worship—a survival of the belief in the fertilizing power of the tree spirit.

The author then discusses the manner in which the tree spirit is "conceived and represented as detached from the tree and clothed in human form, and even as embodied in living men and women," a great number of examples being given. He also gives instances of the double representation of the spirit of vegetation by a tree and a living man. Before concluding this chapter, the question is discussed as to whether these forms of tree-worship help to explain the priesthood of Aricia. He believes they do. "In the first place the attributes of Diana, the goddess of the Arician grove, are those of a tree spirit or sylvan deity. Her sanctuaries were in groves, indeed every grove was her sanctuary, and she is often associated with the wood-god Silvanus in inscriptions. . . . Like a tree spirit, she helped. . . . She was the patroness of wild animals. . . ." He then goes on to suggest that the king of the wood may have been, like the "king of May, the grass king, and the like, an incarnation of the tree spirit or spirit of vegetation, &c."

The next chapter, consisting of a little over 100 pages, deals with the peril of the soul. The royal and princely taboos which kings had to undergo in order to uphold their sacred character in the minds of their subjects are first described, among which we may mention the following. They were compelled to live in a state of seclusion.

Before strangers entered a district they (the strangers) had to undergo certain ceremonies, so as to be disarmed of their magical powers, which might do harm to the king. Great precaution must be observed at meals, in order that they might not be seen eating or drinking, &c. An interesting description of the Mikado's mode of life, written two hundred years ago, illustrates well some of these taboos.

A great number of instances relating to the various ideas of what the soul is and of what it can do are given. Thus, "it is a common rule with primitive people not to awaken a sleeper, because his soul is away and might not have time to get back; so if the man wakeneth without his soul he would fall sick." Some people believe a man's soul to be in his shadow, others in the reflection of his form by water; thus the "Zulus will not look into a dark pool, because they think there is a beast in it which will take away their reflections, so that they die." Very curious instances are given of people running after souls, the methods adopted for catching them, examples of the recall and recovery of souls, &c.

Chapter iii. concerns the "killing of the god." As the author showed in the preceding chapter that the divine priest or king had to undergo horrible taboos, so in this one he points out that, in consequence of the great value attached to his life, the only means of preserving it from inevitable decay necessitated a violent death. He applies this argument to the king of the wood. "He too had to be killed, in order that the divine spirit, incarnate in him, might be transferred in unabated vigour to his successor. The rule that he held office till a stronger should slay him might be supposed to secure both the preservation of his divine life in full vigour, and its transference to a suitable successor as soon as that vigour began to be impaired." In order to confirm the conjecture that the king of the wood was formerly put to death at the expiration of a set time, the author first of all finds the evidence that can be adduced of a custom of periodically killing his counterparts, the human representatives of the tree spirit. As an illustration of these we may mention that in Saxony and Thuringia there is a Whitsuntide ceremony called "chasing the wild man out of the bush," or fetching the wild man out of the wood, the tree spirit or spirit of vegetation being represented by the wild man.

The next step taken in the argument is to show that the "custom of killing the god, and the belief in his resurrection, originated, or at least existed, in the hunting and pastoral stage of society, when the slain god was an animal; and survived into the agricultural stage, when the slain god was the corn, or a human being representing the corn." To do this a great number of examples are taken into consideration; the spring customs of the European peasantry are referred to, among which the most important are known as "burying the carnival" and "driving or carrying out death." The ceremonies carried on in connection with Osiris, Adonis, Thammuz, Attis, and Dionysus by the Egyptians, Syrians, Babylonians, Phrygians, and Greeks, were similar to those in Northern and Western Europe demonstrating the death and resurrection of vegetation. We may here mention that although some writers identify Osiris with the sun, the author is inclined to treat him as a deity of vegetation. Here we fancy modern Egyptologists who are not dependent either upon Diodorus or Plutarch will join issue with him. In like manner Dionysus, though he is often conceived and represented in animal shape, is here understood to be a deity of vegetation, for "the custom of killing a god in animal form . . . belongs to a very early stage in human culture, and is apt in later times to be misunderstood. The advance of thought tends to strip the old animal and plant gods of their bestial and vegetable husk, and to leave their human attributes (which are always the kernel of the conception) as the final and sole residuum. In other words, animal and plant gods tend to become purely anthropomorphic."

In the remaining few pages of this chapter the spirit of vegetation is discussed in examples of the corn spirit; the various names given to this spirit in the different countries being the old man, the old woman, corn mother, maiden, &c. In all these cases the idea is that the spirit of the corn is driven out of the corn last cut or last threshed, and lives in the barn during the winter. Hence the idea brings us in presence of the Egyptian view that Osiris represents the latent Ra. At sowing-time he goes out again to the fields to resume his activity as an animating force among the newly sown corn.

In some cases human sacrifices were made to promote the fertility of the fields. Among many examples given is that of the Indians of Guayaquil (Ecuador), who sacrificed human blood and the hearts of men when they sowed their fields; and there are instances when the victims for these sacrifices were actually kept and fattened up in order that the crops might be good, and that their death might insure immunity from all disease and accidents.

The second volume begins with examples of the corn spirit being represented in animal forms, such as a gander, goat, hare, cat, and fox. During the course of this discussion the author connects this corn spirit in animal form with the ancient deities of vegetation—Dionysus, Demeter, Adonis, Attis, and Osiris. He first of all points out, with the help of numerous references to ancient authorities, how these deities were represented in animal form: Dionysus was represented as a goat and sometimes as a bull; Demeter as a pig, &c. He then argues that since the corn spirit was represented by animals, such as pigs, goats, &c., these animals are nothing more nor less than the corn gods in animal form.

The next point he wishes to prove is that the "custom of killing the god had been practised by peoples in the hunting, pastoral, and agricultural stages of society;" the gods whom the hunters and shepherds adored and killed were "animals pure and simple, not animals regarded as embodiments of other supernatural beings." Of the many examples given concerning this point, we will here give a short extract of the bear festival of the Ainos:—

"Towards the end of winter a young bear is caught and brought into the village. At first he is suckled by an Aino woman; afterwards he is fed on fish. When he grows so strong that he threatens to break out of the wooden cage in which he is confined, the feast is held. But it is a peculiarly striking fact that the young bear is not kept merely to furnish a good meal; rather he is regarded and honoured as a fetish or even as a sort of higher being."

A curious fact about these feasts is that at their conclusion the Ainos always apologize to their gods, saying that the bear has been treated well, only he got too strong for them to keep any longer.

Having thus shown that the custom of killing the god was practised in the hunting, pastoral, and agricultural times, the author points out another aspect of the custom, that of laying on the dying god all the accumulated misfortunes and sins of the whole people. He begins by showing us first how each individual got rid of his sins by transferring them to some person, animal, or thing; then he points out the methods adopted by the inhabitants of villages, towns, &c., for getting rid of their sins wholesale. Some used to drive them into the sea, others used to go through their own village and smash everything, so as to drive them out. Among the principal methods employed was that of the scapegoat. A goat, laden with the sins of the people, was sent out of the village. Sometimes a boat was used as a scapegoat, and sent adrift to sea, filled with provisions and branches of trees in which were placed all the sins and diseases of the people. Human beings were sometimes used as scapegoats and were sacrificed; and the employment of divine men or animals was by no means rare. Thus it appears "that human sacrifices of the sort I suppose to have prevailed at Aricia were, as a matter of fact, systematically offered on a large scale by a people whose level of culture was probably not inferior, if indeed it was not distinctly superior to that occupied by the Italian races at the early period to which the origin of the Arician priesthood must be referred. . . ."

Of the two questions asked at the commencement of this work—Why had the priest of Nemi to slay his predecessor? and Why, before doing so, had he to pluck the golden bough?—the first has been answered, and it only remains to find the answer to the second in the last chapter. The author first inquires what the golden bough was. He begins by mentioning some of the rules or taboos by which the life of the divine kings or priests is regulated, the two chief ones being that they must neither behold the sun nor touch the ground for a specified time. These taboos were intended to preserve the life of the divine person, together with the life of his subjects and worshippers, and the reason why they were suspended between heaven and earth was that their lives were then considered safe and free from any harm. In the description of the Mikado's mode of life it is stated that it would be prejudicial to his dignity and holiness to touch the ground with his feet, and that he should not expose his head to the sun, as its rays are not worthy to shine on it. During the course of this inquiry the author finds out that "these two rules—not to touch the ground and not to see the sun—are observed either separately or conjointly by girls at puberty in many parts of the world," and that they are kept in close confinement, the object of this seclusion being to neutralize "the dangerous influences which are supposed to emanate from them at such times." In these taboos the sun and earth were looked upon as media through which evils or diseases might be transferred, and in order to prevent bad consequences kings and women between certain ages had to undergo this period of isolation and confinement to minimize the chances of infection.

He next gives an account of the myth of a god, whose life "in a sense might be said to be neither in heaven nor earth, but between the two." This was the Norse Balder, the good and beautiful god, who was invulnerable, but who was eventually killed by having a piece of mistletoe thrown at him, and then burnt on a funeral pile. In this section the author traces out what he supposes to be the origin of this myth. He finds that its two main features, the pulling of the mistletoe and the burning of the god, were reproduced in the great midsummer festival of the Celts; and in Sweden there were midsummer fires, known as Balder's bale-fires, which "puts their connection with Balder beyond the reach of doubt, and makes it certain that in the former times either a living representative or an effigy of Balder must have been annually burned in them." He then remarks that "customs of this kind can be traced back on historical evidence to the middle ages, and their analogy to similar customs observed in antiquity goes with strong internal evidence to prove that their origin must be sought in a period prior to the spread of Christianity." May we not here suggest that these customs might have been carried on in the Egyptian temples, since we now know that some of them were oriented to the rising or to the setting sun at either the summer or winter solstice; and that the "manifestation of Ra" was a thing for kings to see? In fact a writer in mediæval times, as referred to on p. 258, vol. ii., "explains the custom of rolling the wheel to mean that the sun has now reached the highest point in the ecliptic and begins thenceforward to descend"; which is exactly what the temples were built for—in order to catch the first rays of the rising or the last rays of the setting sun at these times of the year.

The author then proves that at these solemn rites the fires were regularly made of oak-wood; and shows that since the connecting link of the oak with the mistletoe is given in this very myth, and that "Balder could be killed by nothing in heaven or earth except the mistletoe," then "as soon as we see that Balder was the oak the origin of the myth becomes plain." Thus it is shown that when the god had to be killed, and when the sacred tree had to be burnt, it was necessary in the first instance to break the mistletoe off the tree.

In the two following sections he deals with the "external soul in folk tales" and the "external soul in folk custom"; the former consists of examples selected with a view of illustrating both the characteristic features and the wide diffusion of this class of tales, while the latter shows us that the idea is "not a mere figment devised to adorn a tale, but is a real article of primitive faith, which has given rise to a corresponding set of customs."

In the last section we have a short general summing up, in which the author states the conclusion which he arrives at concerning this strange and recurring tragedy of the priesthood of Nemi. The priest of the Arician grove, or, as he was called, the king of the wood, personated, as we now see, the tree on which the golden bough grew. This tree most probably was the oak, so that he was the personification of the oak-tree. As an oak spirit his life and death was in the mistletoe on the oak, so that as long as the mistletoe remained intact he could not die. In order, therefore, to slay him, it was necessary to break the golden bough, or, in other words,

to cut down the mistletoe, and probably to throw it at him.

Although this work deals with an explanation of the priesthood of Nemi, yet, on the other hand, there is plenty of substance to be got out of it which might help others who are pursuing a similar line of research in other directions. It might be interesting, for instance, to know if there is any connection between the Norse god Balder and the following legend of the Druids, referred to in Flammarion's "Astronomical Myths":—

The night of November 1 was, to the Druids, one full of mystery, in which they annually celebrated the reconstruction of the world. On this day the Druidess nuns had to pull down and rebuild the roof of their temple as a symbol of the destruction and renovation of the earth. If any of these hapless nuns happened to drop any of the materials for this new roof, they were immediately pounced upon and torn to pieces by their companions, who were seized with a fanatic transport. It was also on this day, or rather on this night, that the Druids extinguished the sacred fire, and then all other fires were put out, and a primitive night reigned throughout the land. Then the phantoms of those who had died during the preceding year passed along to the west, and were carried away by boats to the judgment seat of the god of the dead.

Another point we may mention concerns the solemn festival of the Isia, which, like the corroborees of the Australians, lasted three days, and was celebrated in honour of the dead and of Osiris, the lord of the tombs. There is a curious uncertainty about the date of this festival, the author telling us that "from the fact that, when the calendar became fixed, Athyr fell in November, no inference can be drawn as to the date at which the death of Osiris was originally celebrated." Now the Egyptians paid great attention to astronomy, and it has been stated that the day this festival commenced was at the culmination of the Pleiades at midnight.

In drawing to a conclusion our notice of this most interesting study in comparative religion, we must again direct attention to the great amount of labour the author must have undertaken in order to bring before us in a logical order the examples and myths with which these volumes abound. As a book of reference it will be found most valuable, being supplemented by a good index.

W.

GOODALE'S "PHYSIOLOGICAL BOTANY."

Physiological Botany. I. Outlines of the Histology of Phænogamous Plants; II. Vegetable Physiology. By George Lincoln Goodale, A.M., M.D., Professor of Botany in Harvard University. Gray's Botanical Text-book (Sixth Edition), Vol. II. (London: Macmillan and Co., 1890.)

THE first volume of Asa Gray's "Botanical Text-book appeared in 1842, and, in its later editions, "Structural Botany" is still a valued hand-book. Prof. Goodale's "Physiological Botany" forms the second volume, and the series is to be completed by Prof. Farlow's "Introduction to Cryptogamic Botany," and by that fourth volume on the natural orders of Phanerogams which Asa Gray "hoped rather than expected" to contribute.

Prof. Goodale's volume consists of two parts—a group of chapters (192 pages) on the histology of plants, and a section of 281 pages dealing with physiology. The present notice will be confined to the latter part of the book.

The English translation of Sachs's "Vorlesungen" and Prof. Vines's excellent lectures have done much to help the English student of botanical physiology. But in such a large and growing subject we are not likely to be overdone with text-books; we were prepared to welcome a new one, and it was in no unfriendly spirit that we opened Prof. Goodale's pages. We may say at once that our hopes have been disappointed, and that, in spite of a good deal that is worthy of praise, it is far from being a satisfactory book.

A text-book may interest us in one of two ways: it may be written with the vigour and breadth which make such excellent reading of Sachs's "Experimental Physiologie," published some twenty-five years ago; or it may, without being the work of a master, earn our thanks as a repertory of well-gathered and well-handled facts. Prof. Goodale's book seems to us to possess neither qualification in a very high degree.

We are disappointed too in another way. The date on the title-page (1890) naturally led us to look for discussions on the more important points which have arisen during the last three or four years. For instance, we expected a full account of the nitrogen question, a full account of the transpiration question, and at least some account of such interesting work as that of Wortmann, Elfving, and Noll, on geotropic curvature. But these things are not to be found, for the simple reason that the author's preface is dated 1885: we think that the public may fairly ask for some indication, on the title-page, of this condition of things.

It is no doubt a difficult thing to partition out a large subject among a limited number of pages; no two men would do it in the same way, and probably no one would be quite satisfied with the manner of distribution fixed on by another. But Prof. Goodale has exceeded the limits which may be allowed to individuality. For instance, his account of geotropism is compressed into twenty-five lines,—hardly more than is given up to De Candolle's "floral clock," and not nearly so much as is allowed to an account of the hybridization of *Lilium lancifolium* and *L. auratum*. This result—namely, the production of Parkman's lily—is no doubt of interest, but it is surely of less value to the student of physiology than a full discussion of so wide-reaching a mode of growth as geotropism.

Again, in the matter of arrangement some improvement is to be desired. For instance, in chapter xii. (on vegetable growth) we pass directly from the histology of cell-division to an account of the auxanometer. Further on we come across a brief account of turgescence, but without a hint as to its importance in relation to growth. In the paragraph on tension, the author gives no idea of the biological value of the combination of forces in giving rigidity to growing parts. The series of changes known as the grand period of growth is but slightly sketched, and no one coming to the subject for the first time would have a guess at the importance of the phenomenon.

To return to what is said on geotropism. It would surely have been more in accordance with modern views

if an attempt had been made to show that geotropism, heliotropism, hydrotropism, &c., are all parts of one phenomenon: we find, however, no hint that these modes of growth are now regarded as so many different forms of reply to stimulus. Under geotropism, Knight's experiment is not even mentioned, and the student would probably never discover that gravitation *as a stimulus* had anything to do with the matter. Prof. Goodale (p. 392) believes that a negatively geotropic organ curves upwards because the "nutritive fluids" collect "in greater amount in the cells upon its lower side." In the case of positively geotropic organs he seems to believe in the ancient doctrine of plasticity, according to which a root bends down just as a tallow candle collapses in warm weather. He connects this view with the so-called absence of tension in roots; from this we should be led to suppose that he believes all roots to be positively geotropic, but this does not seem to be the case, for he says that "it is a significant fact that in the case of certain branches from roots the direction of growth is oblique."

The treatment of heliotropism is on the same level: he believes in De Candolle's exploded theory, which depends on the fact that growth is favoured by shade, and according to which the difference in illumination on the two sides of the organ is not a stimulus, but the direct cause of curvature.

In the chapter on the movements of plants the account of the clinostat is not good. Prof. Goodale omits to mention the especial merit of this instrument, viz. that it counteracts at one and the same time the effects of one-sided illumination and of the gravitation stimulus. The illustration of the clinostat is singularly unfortunate, being in fact Sachs's drawing of secondary roots bending, under the influence of centrifugal force, in Knight's experiment.

In the discussion on circumnutation it is a pity that no allusion is made to Wiesner's careful critique on the "Power of Movement in Plants." In the same way a modern account of twining plants should give references to Baranetzky's and Wortmann's papers.

Chapter ix., on the "Transfer of Water," is an improvement; still the heart of the matter is hardly touched, and the student who relies on this discussion will be but indifferently instructed. He will not, for instance, have any clear idea that the question whether or no the transpiration-current travels as water of imbibition is or ever was a problem deserving of especial attention.

Further on we find De Vries's experiments on the withering of stems cut in air, and on their preservation from withering when cut under water, but without any reference to von Höhnel's work on negative pressure, which has such important bearings on this point, and indeed on the whole question of water-transfer. In the section on the mechanism of stomata we miss the names of Schwendener and Leitgeb; and under the heading "Relation of Age of Leaves to Transpiration," there is no clear explanation of the relations of stomatal and cuticular transpiration.

In chapter x. a very fair account is given of the assimilation of carbon. The author deserves credit for giving the passage in which, in 1817, the word *chlorophyll* was proposed; just as in another part of the book he gives the passage in which the term *protoplasm* was first employed. With regard to chlorophyll we think it a pity that any encouragement should be given to the confusion between chlorophyll and chloroplasts by such a remark as the following: "The term chlorophyll originally applied to the pigment rather than to the substance which contains it, is now used indifferently to denote the coloring-matter and the portions of protoplasmic mass which are tinged by it." This statement is all the more unnecessary because he gives on the next page a useful table of the plastid-nomenclature of Schimper, Meyer, &c. Pringsheim's hypochlorin theories are reproduced, but without the word of warning that should accompany such speculations in a book intended for students.

There is a fair account of Timiriazeff's and of Engelmann's work on assimilation; but we doubt whether it would induce the beginner to appreciate the extraordinary interest and importance of Engelmann's researches. The section ends with an outline of the "early history" of assimilation, which contains some interesting quotations from Priestley and Ingenhousz.

The section on the "Appropriation of Nitrogen" suffers grievously from the fact that the nutrition of Fungi is left out of account. The "Synthesis of Albuminous Matter" is inadequately treated, and the same must unfortunately be said of the action of ferments; and with regard to the origin of alkaloids it would have been better to have given the well-known hypothesis that they are waste products, rather than to have left their meaning in complete obscurity.

Chapter xiv. is devoted to reproduction: the author seems to have been hampered with the fear of overlapping the forthcoming book on Cryptogams, as he confines himself almost entirely to the higher plants. He gives, in a footnote, some account of the reproduction of Spirogyra, Fucus, Nemalion, Funaria, Pteris, and Selaginella, but gives no idea of the connection between this latter form and the Spermaphytes. It is clear that without a free use of the lower forms it is impossible to give such a generalized view of the reproduction of plants as is appropriate in a physiological text-book.

In discussing the colours of flowers, it would have surely been better to have given H. Müller's interesting generalizations in place of the barren statistics of Kohler and Schübeler. The chapter concludes with some useful facts on hybridization.

The last chapter in the book consists of a few pages on germination. The greater part of this discussion might with advantage have been divided among those parts of the book which deal with the general conditions of plant life and with metabolism. Of the interesting growth-phenomena of germination, such as the protrusion of the radicle, the manner in which the cotyledons are freed from the seed-coats, &c., some account should have been given, even at the risk of overlapping vol. i. of the Text-book.

In spite of a general faultiness of the kind indicated the book is not without value. It is clearly written, and contains the substance of a large number of books and papers, references to which are given at the foot of the page (instead of at the end of the chapters) to the very great convenience of the reader. Many of these references to older papers are likely to be useful, and of salutary effect on the rising generation of botanists, who are somewhat inclined to overlook the work done in the days of their grandfathers.

The author deserves credit for his appendix, in which a series of simple physiological experiments are described, with a view to their repetition by the student.

FRANCIS DARWIN.

OUR BOOK SHELF.

Plant Organization: a Review of the Structure and Morphology of Plants by the written method. By R. Halsted Ward. (Boston, U.S.A.: Ginn and Co., 1890.)

THIS is nothing more than a series of blank charts, intended for students to fill in with the details of plant descriptions. The charts are prefaced by a few pages of letterpress, wherein are contained some of the author's views on plant morphology, together with general hints and a summary of the terminology to be used. We cannot say that the author's attempt to simplify the technical terms ordinarily made use of in descriptive work is altogether a success. For instance, the words "shingled" and "straddling" for *imbricate* and *equitant*, will hardly recommend themselves to teachers on this side of the Atlantic; nor are plants either epiphytic or parasitic on *rocks*. As to the blank charts which constitute the feature of the book, it can only be said that, as such things go, they are entirely praiseworthy. But are charts of this kind really necessary? A child just beginning the subject may profitably make use of the very simple schedules devised by the late Prof. Henslow; but by the time he has advanced so far as to be able to use these complicated and detailed ones, drawn up by Mr. Ward, we think he will do much better without being kept in leading-strings. The advantage gained by writing descriptions will be vastly enhanced if he be now permitted to think a little for himself.

F. W. O.

Geometrical Conics. Part I. The Parabola. By Rev. J. J. Milne, M.A., and R. F. Davis, M.A. (London: Macmillan and Co., 1890.)

IN this work a departure is made from the general order of the propositions adopted by most geometrical writers "so as to bring the argument into closer agreement with that found in analytical text-books, in order that both methods may be studied side by side." Instead of a series of detached propositions, the authors have made a continuous treatise, and by this means have been able to deal with some of the more important points more fully than they otherwise could have done.

This part, which treats of problems and theorems relating only to the parabola, is thoroughly well done, and contains many problems fully worked out which are absent from other similar books.

Those reading the subject for the first time ought to have no difficulty in grasping the various propositions and theorems, and at the end numerous examples on them, with hints and solutions, are added.

Short Logarithms and other Tables. By W. Cawthorne Unwin, F.R.S. Fourth Edition. (London: E. and F. N. Spon and Co., 1890.)

THE short tables given in this book will be found to serve the purpose for which they were intended, which is to facilitate practical calculations and to solve arithmetical problems in a very complete way. The logarithmic table is very short, but, if used properly, the error need not exceed one per thousand; logarithms of three-figure numbers to 999, and of four-figure numbers to 2000, are given.

Amongst the other tables are: anti-logarithms, natural and logarithmetic trigonometric functions, functions of numbers, product of numbers, table of weights and measures, and conversion tables for English and metric measures. The last-named table is inserted specially for the use of engineers, as so many treatises on engineering are now being published in France and Germany in which the measures are given according to the metric system, and in consequence of which constants for the quick conversion of these measures are required. W.

Elementary Algebra. By Charles Smith, M.A. (London: Macmillan and Co., 1890.)

THIS is a second edition of this well-known book, and differs from the first in some important particulars. It has been thoroughly revised, and the early chapters have been simplified and remodelled. Chapters on logarithms and scales of notation form a useful and valuable addition, and there is a great increase in the number of the examples. For beginners this work should prove invaluable, and even more advanced students would do well to glance over its pages. W.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

British Association Procedure.

I SHOULD be sorry if Prof. Lodge or anyone else should suspect me of a desire to interfere with the opportunities which are afforded by meetings of the British Association for friendly intercourse between workers, and especially between the younger scientific men and their seniors, for I feel that those opportunities constitute one of the chief advantages of attending the meetings. But with the desire to avoid waste of time in merely journal business I should prefer that each Sectional Committee should be reduced to a small executive body to whom could be entrusted the task of arranging the programme for each day, and in a preliminary way other business, such as the selection of committees to carry out suggested new researches. The appointment of such Committees and the other business would be accomplished quickly enough at a meeting of the whole Section, and then opportunity would be given to all the members for expressing an opinion or offering suggestions. The plan at present adopted is neither one thing nor the other. The Sectional Committees are too large for the despatch of business, and yet may not include every desirable member of the Section. The demand for election to which I referred comes from a certain class of people whose single purpose is served when they get their names printed on the list.

I happen to have by me the journals of the Birmingham meeting, and the number of names on the Committees of the first three Sections I find as follows:—

	Section A	B	C
Vice-Presidents ...	6 ...	9 ...	7
Secretaries	4 ...	5 ...	4
Committee	52 ...	51 ...	93
Totals	62	65	104

When numbers like this are reached why pretend to draw a line at all?

WILLIAM A. TILDEN.

Birmingham, September 23.

The Exploration of Central Asia.

THE late notice in NATURE of August 14 (p. 378) with reference to the work of exploration now being carried out by the Russians around Kashgar, and that M. Grombchevsky, having received permission and funds to continue his work, was starting for Rudok, is not pleasant reading for Englishmen who know that part of the Himalayas. Rudok is a small place with a fort and Gonpa or monastery, and gives the name to the tract of country lying at the eastern end of the great Pangkong Lake, on the very confines of the territory of the Kashmir State. In 1863 I carried the survey up to that extreme eastern limit, and succeeded by avoiding observation in getting within a very few

miles of Rudok itself. The news was soon conveyed there, and the Governor, a native of Lhassa, came out to meet me. He brought presents of tea, sheep, and goats, and was most civil, but begged that I would go back, as he would lose his appointment and be disgraced if it became known that he permitted me to advance further. His politeness disarmed opposition, and my orders, given in writing, were not to get into collision with the Tibetans. We drank a good deal of tea, made in their mode churned with butter and salt, which was always simmering in his tent, and I managed to persuade him to let me ascend a conspicuous peak a few miles further on, and from which I obtained a magnificent panorama of the lake-dotted plain to the eastward of Rudok. We parted excellent friends, and I presented him with a single-barrelled pistol, in return for the presents he had given us. I feel sure that had I been able to get back there the following year, I could, starting from other points, have got very much further to the eastward, and returned again *viâ* Rudok itself. I was, however, sent to another and equally interesting part of the Himalayas.

This country of Rudok is now, in 1890, to be visited, examined, and reported upon by the Russians. Twenty-seven years have gone by since I was on its very threshold. In the interval we have had political officers appointed Residents in Leh, we have seen many journeys made by English officers and English traders to Yarkand, and yet no one has penetrated into Rudok and all that unknown country on the north and north-east which is much nearer. It does not say much for our British energy that a Russian is now to enter this area, and is now perhaps surveying within almost, I may say, a stone's-throw of our own border, which we have made no attempt to get into and know. Perhaps M. Grombchevsky may not succeed, perhaps he may lose his life, but that does not detract from the activity and devotion the Russians are at present giving to the exploration of Central Asia down to the Himalayan chain, or prevent their doing so. If they from their base can do this, why can we not ourselves? We have been content to send in natives of India, but this is not the same thing as sending European officers, for in one case the information obtained is purely topographical, no actual knowledge of physical features is gained, nothing from a military point of view, and no personal acquaintance is made with the people which might be of political or other advantage hereafter. Proceeding to the north-west of Ladak, where the Russians have lately been exploring, it appears extraordinary, with the knowledge the Government of India possessed of the vast system of glaciers of the Mustakh, south of the main range, that no attempt has been made during the past twenty-five years to finish that tract of country, and map the glaciers which descend on the north or Yarkand side, and trace the rivers flowing from them, which would be easy to accomplish, and with little or no danger of interruption. This I consider would be of far more importance and of infinitely greater interest scientifically than spending thousands of rupees on large-scale surveys of Indian hill stations and cantonments, or the resurvey of parts we know well on larger scales.

Although the Indian Survey and the Quarter-Master-General's department have made us acquainted with vast tracts of country, yet much more might have been explored if persistent efforts of every kind, along the line of the Himalayas from Kashmir to Assam had been made during the past thirty years, and if the Government of India had given encouragement to officers who were able to survey and to make the most of their opportunities to do so. I can remember when many such good opportunities have been lost, owing to a contrary policy, for fit men ready to go have not been wanting; also, when such opportunities have been taken, and at a time when the Government would not have given their sanction had it been applied for, as, for instance, when Mr. Johnstone, an uncovenanted assistant of the Kashmir Survey party proceeded to Yarkand alone, and returned in safety in 1864, bringing back a large addition to the then complete blank of intervening country, and fixing with some exactitude the position of the large cities he visited. We thus have left and are leaving to Russian subjects, who have the good wishes and countenance of their Government, to survey tracts of country lying upon our line of frontier, and we shall probably see them the first of European nations to plant their feet in Lhassa. They go to work on the right system, for much more can be done by single individuals in a quiet way, with a few carriers and attendants, than by organizing large unwieldy missions, with a little army of camp-followers and sepoys, such as it was proposed to send from Darjiling some few years ago. Such preparations become magnified into an army with aggressive aims, certain to arouse political difficulties; it is a burden on the resources of the country it has to pass through, and the possibility of misunderstandings and quarrels arising over the collection of and payment for the same.

We might have been working for years past to the northward, in many directions, by small exploring parties, and have now possessed an intimate knowledge of the physical features of the country, and its zoology, fauna, and flora, such as the Russians do in their thorough manner, but which our Government appears not to understand the value of, eminently unscientific as it is. After all, disagreeable though it be to see opportunities lost, those who do appreciate scientific methods of work must thank Russian explorers, such as Prejevalsky, and now Grombchevsky, for the light they have, in the last few years, thrown on the geography and natural history of Central Asia, from Siberia south towards British India. H. H. G-A.

Variability in the Number of Follicles in Caltha.

IT is easy to understand, supposing a tendency to variability, that characters of little value (as the colours of certain domesticated animals) might vary considerably, because not kept in check by natural selection. If it does not matter to a species whether it is unicolorous or spotted, for instance, one can see how both varieties may coexist without any tendency to the formation of a new species, and it might be rather an advantage than otherwise that individuals should differ from one another. But those parts connected with so important a function as the reproduction of the species would, one might suppose, be rigidly guarded over by the survival of the fittest, and any great variability in the number of offspring would hardly be expected within the limits of a species.

That such variability exists, however, we have abundant proof. The variability in the number of follicles in the Ranunculaceæ is astonishing. Coulter ("Manual of Botany of Rocky Mountain Region") gives the pods of *Caltha* as from 5 to 12; but this does not nearly represent the amount of variation. *Caltha leptosepala*, DC., is very abundant at West Cliff, Colorado, and this year I examined a number of specimens of the flowers, and counted the follicles, with the following result:—

Follicles.	Specimens.
2	1
3	7
4	4
5	11
6	3
7	11
8	10
9	7
10	4
11	5
12	1
13	5
14	3
15	1
Total	73

It thus appears that 73 flowers presented as many as 14 variations in the number of follicles, and curiously, the odd numbers are more numerous than the even, in the proportion of 47 to 26.

Miss Lowther and Miss Byington, of West Cliff, were good enough to search for variations other than those tabulated above, and they succeeded in finding specimens with 1, 18, 23, and 25 follicles respectively. T. D. A. COCKERELL.

3 Fairfax Road, Bedford Park, Chiswick, W.,
September 16.

The Origin of Mélinite and Lyddite.

(Picric Acid.)

IN your issue of the 4th inst. (p. 444) there occurs the following sentence:—

"Although picric acid compounds were long since experimented with as explosive agents, it was not until a very serious accident occurred, in 1887, at some works near Manchester, where the dye had been for some time manufactured, that public attention was directed in England to the powerfully explosive nature of this substance itself."

As this sentence forms part of this year's great annual scientific manifesto, with which Presidents of the British Association for the Advancement of Science are wont to favour your readers, I trust your love of scientific precision will help me to point out that, "*prior*" to the very serious accident near Manchester, public attention "*was*" directed in England to the powerfully explosive nature of this substance itself through the medium of a very serious publication in London, or rather through the medium of two very serious publications—viz. a patent and a paper read before the Chemical Society, as you will see from the following statement,[1] which I drew up last spring at the request of and, as I hoped, for the use of my distinguished fellow-inventor, the President of the Government Committee on Explosives, and now President of the British Association for the Advancement of Science. H. SPRENGEL.

54 Denbigh Street, S.W., September 13.

A Recently Established Bird Migration.

BURIED in the heart of a newspaper article of the 4th inst., on incorporated Worthing, is a statement which, if it may be relied on, seems to me of curious, if not unique, interest, inasmuch as it dates very closely what seems now an annual migration of birds. After speaking of West Tarring as dividing with Lancing the title of the capital of English Figland, the journalist (*Daily Telegraph*, September 4) goes on to say, "There it was that Thomas A'Becket planted the first slip—now a mouldering stump—whence, it is said, all these shady alleys, redolent of syrupy sweetness, derive their origin. There is no handsomer shrub-tree than the fig, spreading forth its many-veined, broad leaves in grateful shade, while the fruit, varying from juicy green acorns to great purple bulbs—I bought some yesterday four inches in length—peer boldly forth from every available twig. Even that discriminating bird, the Italian beccafico, has become aware, in some mysterious way, of the existence of the Worthing fig-gardens, and comes over to spend a pleasant six weeks among them, just as we go for change of air to Switzerland or the Black Forest. This is the time for his arrival, and if I may judge by certain well-picked figs on the Tarring trees, I should say that he had taken up his quarters somewhere in the immediate vicinity of the noble thirteenth century church."

We may reasonably allow a century or so from the time of Henry II., before the fig-tree would be sufficiently acclimatized and established at Worthing to attract such visitors. And then, always supposing that it is the Italian beccafico (*Motacilla curruca*, Linn.) which comes, it seems probable that he follows fig-harvest along the Riviera, and up from Southern to Northern France; though how so delicate and toothsome a mouthful manages to run the gauntlet of the continual potting which almost exterminates bird life over great breadths of that long journey is more difficult to understand. And then is it possible that a bold spirit of adventure, rather than any well-grounded certainty of knowledge, led the first comers across the Channel? Because it is a strange fact vouched for by more than one observer, and which goes dead against the old unerring instinct theory, that occasionally in the autumn migration, long streams of our emigrants make boldly out to sea from our westernmost coast where there is no land nearer than the east coast of America, and the whole flight must needs perish.

But as this whole question of bird migration is still one of the most dimly-lighted regions in the whole arcana of natural history, and its beginnings in most cases go far back into immemorial time, I trust—despite the great demands just now of the British Association reports on your valuable space—that you will kindly give some competent ornithologist, resident at, or a visitor to Worthing, the opportunity of confirming, if the fact is so, that the Italian fig-pecker has formed the habit of attending fig ripening there since the time of Thomas A'Becket.

HENRY CECIL.

Bregner, Bournemouth, September 9.

The Common Sole.

MR. CUNNINGHAM, in his valuable "Treatise on the Common Sole," recently published, remarks (p. 125), "Why I have failed to obtain soles in the first year of their growth, after the stage of those found at Mevagissey in May, I cannot understand." It may be of interest to those who are studying this subject to know that, among the investigations organized by the Royal Dublin Society, and intrusted to my care on board the s.s. *Fingal* off the west of Ireland, during the past summer, the working out of the life-history of sea fish took a prominent place.

In August, soles born in February and March were not found in shallow water, though careful search was made for them. Outside 50 fathoms we began to meet them. In 80 fathoms we took them in abundance, and also found them in the stomachs of other fish captured by the trawl in similar depths.

WILLIAM SPOTSWOOD GREEN,
H.M. Inspector of Irish Fisheries.

Dublin Castle, September 22.

A Meteor.

AT about 7.49 p.m. on the 14th inst., I saw from the garden of the Pavilion Hotel, Folkestone, an unusually large and bright meteor descend towards the north-west point of the horizon. The long and full tail left behind, like that of a large rocket, enabled one to trace its path, which at its highest point was about 6° or 8° north of Arcturus. The meteor, which was very much larger apparently than Jupiter, descended very slowly along a slightly wavy line of a mean inclination of about 75° to the horizon. The end of its path was hidden by houses on the "Bayle." J. PARNELL.

Pavilion Hotel, Folkestone, September 19.

THE WHITE RHINOCEROS.

WRITING of his sporting adventures on the River Se-whoi-whoi (a confluent of the Umniati) in Southern Mashuna-land, Mr. F. Selous, in the *Field* of August 16, says as follows:—

"It was within a mile of this spot that, two years previously [*i.e.* in 1883], I shot two white rhinoceroses (*Rhinoceros simus*), the last of their kind that have been killed (and, perhaps, that *ever will be killed*) by an Englishman. They were male and female, and I preserved the skin of the head and the skull of the former for the South African Museum in Cape Town, where they now are. I shall never cease to regret that I did not preserve the entire skeleton for our own splendid Museum of Natural History at South Kensington; but when I shot the animal I made sure I should get finer specimens later on in the season. However, one thing and another prevented my visiting the one spot of the country where I knew that a few were still to be found, and now those few have almost, if not quite all, been killed; and, to the best of my belief, the great white, or square-mouthed, rhinoceros, the largest of modern terrestrial mammals after the elephant, is on the very verge of extinction, and in the next year or two will become absolutely extinct. If in the near future some student of natural history should wish to know what this extinct beast really was like, he will find nothing in all the museums of Europe and America to enlighten him upon the subject but some half-dozen skulls and a goodly number of the anterior horns."

The skin of the head of the male white rhinoceros shot by Mr. Selous on the occasion spoken of above was forwarded by the authorities of the South African Museum to Mr. E. Gerrard, Jun., of Camden Town, to be mounted for their collection. Mr. Gerrard, knowing the rarity of specimens of this animal, was kind enough to allow the mounted head to be exhibited at a meeting of the Zoological Society of London in 1886, along with a corresponding head of the (so-called) black rhinoceros (*R. bicornis*), so that an easy comparison might be made between them.

The differences between the external forms of the heads of the two African rhinoceroses, though not, perhaps, so striking as the well-known differences in their skulls, are sufficiently obvious on comparison. I will venture to point them out in the pages of NATURE, in the hope that the attention of the several exploring parties now traversing Mashuna-land and Matabeli-land may be called to this subject, and that, in case of a straggling

[1] We have not considered it necessary to print this statement.—ED.

survivor of the white rhinoceros being met with, it may be carefully preserved for the National Collection at South Kensington.

As will be seen by the outline drawings of the heads,[1] the points by which this part of the two animals may be distinguished present themselves very appreciably. In the first

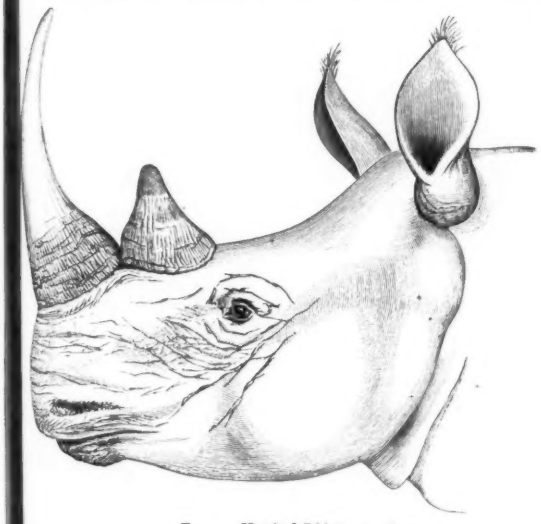


FIG. 1.—Head of *Rhinoceros simus*.

place, as is already well known, the "white" or "square-mouthed" rhinoceros (as it is much better called) is distinguished by its short upper lip. In *R. bicornis* the central portion of the upper lip is far extended, and forms a quasi-prehensile organ. This is sufficiently manifest in the drawing, but may be still better seen in the living example of the same animal now in the Zoological Society's Gardens.

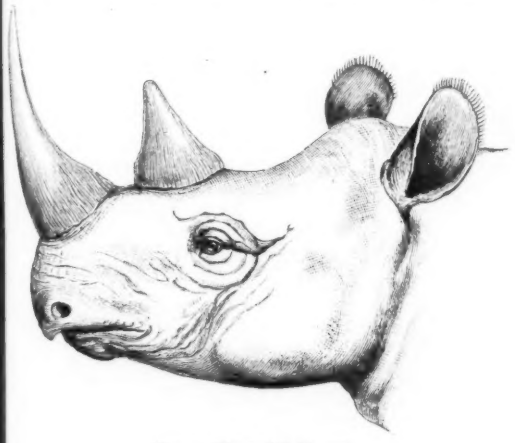


FIG. 2.—Head of *R. bicornis*.

A second point in which the heads of the two African rhinoceroses differ materially is in the size and shape of the ears. In *R. bicornis* (Fig. 2) the ear-conch is much rounded at its extremity, and edged by a fringe of short black hairs which spring from the margin. In *R. simus* (Fig. 1) the ear-conch is much more elongated and sharply pointed at its upper extremity, where the hairs which clothe its margin constitute a slight tuft. While the upper portion of the ear-conch is much more expanded in *R. simus* (than in *R. bicornis*), in the lower portion the two margins are united together for a much greater extent, and form a closed cylinder which rises about 3 inches above the base.

A third point in which the two species appear to differ is in the shape of the nostrils, which in *R. simus* are elongated in a direction parallel with the mouth, while in *R. bicornis* they are more nearly of a circular shape. Again, the eye in *R. simus* appears to be placed further back in the head than in *R. bicornis*.

In conclusion, I wish to call special attention to what Mr. Selous has already said—that no museum in Europe or America possesses a specimen of this huge animal, and to point out that the country, in which alone (as is possible but by no means certain) the last stragglers exist, being now within the British Empire, it is clearly our duty to endeavour to obtain and preserve examples of the great white or square-mouthed rhinoceros for the use and information of posterity.

P. L. SCLATER.

[1] Reduced from P.Z.S., 1886, Pl. xvi.

RECENT RESEARCH AMONG FOSSIL PLANTS.

AN instructive *résumé* of recent work among fossil plants is given by the Marquis de Saporta in the *Revue générale de Botanique*, vol. ii., 1890. It appears that mosses were almost certainly represented in the Palæozoics, a species allied to Polytrichum having been discovered at Commentry, in France. Rarely as the fructification of ferns is preserved in the Coal-measures, twenty species are now investigated, confirming the view that the Palæozoic species differed widely from the present. Half of them are most nearly related to the Marattiaceæ, whilst others show affinities with the Osmundaceæ, Gleicheniaceæ, and Hymenophyllum, the vast order of Polypodiaceæ, and the Cyatheæ being unrepresented. Among the most striking discoveries in the Coal-measures is a fern trunk several yards in length, with its fronds attached. The view that the Calamarias were in part Gymnosperms is all but universally abandoned, and the close affinity of the Lepidodendrons and Sigillarias and their cryptogamic nature everywhere admitted, so that a long controversy is ended, and the truth of Prof. Williamson's contentions definitely established. Links in the chain of evolution between Cryptogams and Gymnosperms still elude our search, and the earliest vegetation of which we have any complete knowledge already presents well-developed Gymnosperms in the shape of the deciduous Cordaïtes, a few Cycads and obscure Taxads allied to Ginkgo. At the same time, we get rid of the very puzzling Spirangium, so often regarded as a possible Palæozoic Angiosperm, but now relegated by MM. Renault and Zeiller to the animal kingdom as the egg of some member of the shark family.

Under the apparently totally dissimilar climatic conditions of the Mesozoic, the overgrown luxuriant vegetation of the coal period is replaced by forests of dry scale-leaved Coniferæ, with undergrowths of small-leaved ferns and Cycads. Fructification shows the presence of Cycadeæ in the infra-Lias, and Polypodieæ in the mid-Jurassic. The researches of Count Solms into the organization of the obscure and extinct Cycad Bennettites, bid fair to clear up another important and hitherto insoluble problem—the true botanical position of Williamsonia. Work in the past year or so has been destructive to a great deal of even recent literature on the geological history of plant evolution, the foundations of all speculative writing on this subject having as yet proved most treacherous sand.

The first appearance of Dicotyledons, once supposed

to coincide with the Tertiary period, is pushed back farther and farther into the Secondary; a flora in the United States, otherwise Jurassic in facies, containing no less than seventy-five species, or more than 20 per cent. of Phanerogams, according to Lester Ward. In England the mysterious Wealden, which from analogy should preserve rich fossil floras shedding light on the origin of Angiosperms, yields little but tubers and stems of Equisetum, scraps of ferns and conifers, and a unique liliaceous stem; while our Greensands, Gault, and Chalk afford little or nothing from which the existence of flowering plants during their deposition could be inferred. The veil which has proved absolutely impenetrable in our country, and has so long enshrouded the dawn of dicotyledonous vegetation, seems, however, about to be lifted, and we wait with the utmost interest the publication of the infra-Cretaceous floras of the Potomac by Prof. Fontaine, and of the oldest European Dicotyledons, from the beds of Gault age in Portugal, by Saporta. Though, however, the forms will be revealed, a long time must probably elapse before we can hope to rightly interpret them. J. STARKIE GARDNER.

ON THE INFLUENCE OF HEAT ON COPPER POTASSIUM CHLORIDE AND ITS SATURATED SOLUTION.[1]

THE blue crystals of copper potassium chloride, $CuCl_2.2KCl.2H_2O$, when heated to upwards of 100°, change their colour, and a closer investigation proves such is due to the formation of a new brown salt, $CuCl_2.KCl$, according to the equation—

$$CuCl_2.2KCl.2H_2O = CuCl_2.KCl + KCl + 2H_2O.$$

This same new substance can be obtained at lower temperatures, on heating the blue double salt in presence of copper chloride; it then results according to the following symbols—

$$CuCl_2.2KCl.2H_2O + CuCl_2.2H_2O = 2CuCl_2.KCl + 4H_2O.$$

Both transformations are reversible—*i.e.* the primitive substances are obtained anew on cooling, and both take place at definite temperatures, 93° and 56° respectively, which temperatures can be accurately determined in studying the abrupt change of volume which accompanies that of chemical composition.

The temperatures of 56° and 93° are, moreover, characterized by an intersection of three curves of solubility in each case, viz.—

1. At 56° the following three will meet—

(*a*) That of the system $CuCl_2.2KCl.2H_2O$; $CuCl_2.2H_2O$.
(*b*) That of the system $CuCl_2.2KCl.2H_2O$; $CuCl_2.KCl$.
(*c*) That of the system $CuCl_2.KCl$; $CuCl_2.2H_2O$.

2. At 93°—

(*a*) That of the system $CuCl_2.2KCl.2H_2O$; ClK.
(*b*) That of the system $CuCl_2.2KCl.2H_2O$; $CuCl_2.KCl$.
(*c*) That of the system $CuCl_2KCl$; ClK.

Lastly, those same temperatures are characterized also by an intersection of four vapour pressure lines at each, viz.—

1. At 56° those of the above-mentioned three saturated solutions, and that of the dry blue salt, mixed with copper chloride, meet.

2. At 93° those of the other three mentioned above and that of the dry blue salt, mixed with potassium chloride. J. H. VAN'T HOFF.

[1] Abstract of a paper read at the Leeds meeting of the British Association.

THOMAS CARNELLEY.

BY the death of Prof. Carnelley the science of chemistry in this country has suffered an irreparable loss. It appears that some little time ago Dr. Carnelley had been suffering from an attack of influenza, and it was whilst returning to Aberdeen after a journey to the south, made with the object of recruiting his health, that he was seized with sudden and severe illness, which was due, as his medical attendants discovered, to the formation of an internal abscess. Surgical aid proved unavailing, the patient's strength gradually gave way, and Dr. Carnelley passed away at mid-day of August 27, at the comparatively early age of thirty-eight.

Prof. Carnelley was a native of Manchester, the son of Mr. William Carnelley, Chairman of the directors of Messrs. Rylands, Limited, of that city. His early education was received at King's College School, London, and it was during this period, whilst attending the evening classes at King's College, that Carnelley began the study of that science with which he in after life identified himself. In 1868 he entered the Owens College, Manchester, gaining one of the Dalton Entrance Mathematical Exhibitions. During his career as a student, an exceptionally brilliant one, he busied himself not only with the study of the many subjects required of graduates in science of the London University, but found time to devote special attention to his favourite science, and carried out an original investigation on the vanadates of thallium, for which he received in 1872 the Dalton Chemical Scholarship. In this year also he obtained the degree of Bachelor of Science of the University of London, gaining at the final examination for this degree marks qualifying for the scholarship in chemistry, in consequence of which he held the Dalton Chemical Scholarship for an additional year. During the next two years he acted as private assistant to Prof. Roscoe, and commenced his career as a teacher by giving lectures in connection with the evening classes of the Owens College. During the year 1874-75 he continued his studies at the University of Bonn under Profs. Kekulé, Zincke, and Wallach; and on his return to England in 1875 was appointed Demonstrator and Assistant-Lecturer in Chemistry in the Owens College under Prof. Roscoe. During the time that he held this appointment he also acted as Principal of the North Staffordshire School of Science at Hanley, where his teaching proved eminently successful. In 1879 Carnelley, who had taken the London degree of D.Sc., was appointed to the newly-founded chair of chemistry in the Firth College, Sheffield, and, after three years' successful work in this institution in fitting up the chemical laboratory and inaugurating the teaching of chemistry in this College, he passed on to the then recently endowed University College of Dundee. Here ample means were placed at his disposal, and he had the satisfaction of superintending the erection of a block of buildings in which are located the chemical laboratories, lecture-rooms, &c., which he had designed and carefully planned. Under his guidance the Chemical Department of the Dundee College rapidly developed; his enthusiasm, his forgetfulness of self, his unstinted energy, and his ability and zeal as a teacher, all combined to make his department the most important one in the new College and to endear him to his students. Signally successful as was Carnelley's career in Dundee as a professor of chemistry, he also in many other ways conferred lasting benefits on the town and its inhabitants, amongst whom he spent six years, perhaps the most active of his life, and his acceptance of the appointment to the chair of chemistry at the University of Aberdeen in 1888 caused universal regret in Dundee.

Amidst his many duties, first at Owens College, then at Firth College, and afterwards at University College, Dundee, where he conducted both day and evening

classes and superintended the teaching in the laboratories, Dr. Carnelley did not forget that the first duty of a man of science is to advance his subject. That he did so with good effect is seen from the numerous communications of importance contributed to the various learned societies both in this country and in Germany, either alone or in conjunction with other investigators. Prominent amongst the researches with the results of which he has enriched science are those by which he sought to extend the application of Mendeléeff's discovery of the "periodic law," in accordance with which the chemical and physical properties of the elements and of their compounds are periodic functions of the atomic weights of the elements. Carnelley, when a student at the Owens College, appears to have been greatly impressed with Mendeléeff's conceptions, and it was to the study of the physical properties of the elements and their compounds, and to the devising of new methods of obtaining trustworthy determinations of the melting-points of metallic salts and the elements, that he early devoted his energies. The results of these experiments were subsequently utilized to show that the fusibility of the elements and of certain of their compounds is a periodic function of their atomic weights. From the relationships discovered by him to exist between the melting-points of the chlorides of the elements and the atomic weights of those elements Carnelley was led to draw conclusions respecting the atomic weight of the element beryllium and to fix its position in the classification of the elements.

Other physical properties have been shown by Carnelley to be related to the atomic weights of the elements, and in a paper read at the Aberdeen meeting of the British Association he developed a series of analogies between the elements and various series of hydrocarbons, from which he concluded that the chemical elements may be represented by a formula $A_nB_{2n+(2-x)}$, in which n is the series and x the group to which the element belongs; $A = 12$ and $B = -2$. In a paper published in the *Philosophical Magazine* in January last, he tells us that since 1872 he had attempted to give the periodic law a simple numerical expression, and states that early in the summer of 1889 he had obtained such an expression, in which the atomic weight is represented as equivalent to the product of a constant, c, into a factor made up of m, a member of an arithmetical progression, dependent on the series to which the element belongs, and v, the maximum valency, or the number of the group of which the element is a member. Thus—

$$A = c\left(m + v^{\frac{1}{x}}\right).$$

The best results are obtained when $x = 2$, and m is 0 for series II., $2\frac{1}{2}$ for III., 5 for IV., $8\frac{1}{2}$ for V., 12 for VI., $15\frac{1}{2}$ for VII., 19 for IX., $22\frac{1}{2}$ for X., 26 for XI., and $29\frac{1}{2}$ for XII.

The formula thus becomes $A = c(m + \sqrt{v})$, and m is a member of an arithmetical series in which the difference is $3\frac{1}{2}$, save in the first two series, when it is $2\frac{1}{2}$. By using this equation, the value for c in the case of 55 elements is found to lie between 6·0 and 7·2, with a mean value of 6·64. Accepting 6·6 as the value of c, the calculated atomic weight of sodium, for example, would be found as follows:—Sodium is the first member of series III., m is therefore 2·5 and $v = 1$, so that $A = 6{\cdot}6(2{\cdot}5 + \sqrt{1})_{\cdot} = 23{\cdot}1$. In the paper referred to the atomic weights of all the elements are given as calculated by this formula, and compared with those generally accepted. The results obtained exhibit very near approximation, the calculated values being, in fact, nearer the experimental numbers than those obtained by the aid of Dulong and Petit's law. The remarkable coincidence that the value 6·6 for the constant c in the above formula very nearly approximates to the value 6·4, accepted as the atomic heat of the elements, in acccordance with Dulong and Petit's law, is noted, and that the specific heats of the elements may consequently be represented as equivalent to $\frac{1}{m + \sqrt{v}}$. The specific heats calculated by the aid of this formula are compared with the experimental values, and in the case of the 55 elements, in which a comparison can be instituted in 45 instances the agreement is very satisfactory, while the other 10 are elements the specific heats of which, according to Dulong and Petit's law, are more or less abnormal.

Accepting Bettone's conclusion that the hardness of an element is inversely proportional to its specific volume, it is shown that hardness may be represented in terms of the specific gravity, and the expression $6{\cdot}6(m + \sqrt{v})$, thus—

$$\text{Hardness} = \frac{1}{\text{spec. vol.}} = \frac{\text{sp. gr.}}{\text{at. wt.}} = \frac{\text{sp. gr.}}{6{\cdot}6(m + \sqrt{v})}$$

But Carnelley's energies were not alone given to the investigation of questions of a purely scientific interest, for, naturally, one situated as he was all his life in the midst of active industrial communities found many opportunities of applying his knowledge and training for the benefit of those around him. Notably was this the case in the valuable examinations, chemical and bacteriological, of the air of dwellings, schools, &c., in Dundee and district, in a report to the School Board, of which he was an active member. Much valuable information was brought to light by these investigations, and it would appear that one result attained was the realization by the authorities in Dundee, Aberdeen, and some other towns, of the necessity of making provision in schools for the supply of a pure aërial food for the scholars. This subject—the ventilation and heating of schools, &c.—was, we believe, one with which he was busily engaged at the time of his last illness, and it is to be hoped that the labour which he expended upon it will be continued by one of his competent collaborateurs.

Prof. Carnelley was also the author of an elaborate and most valuable compilation of certain physical constants of chemical compounds, published in two large volumes, a monument of industry and devotion to science: he was, moreover, an extensive contributor to the German-English dictionary of scientific and technical terms published by Messrs. Vieweg and Son, of Brunswick.

Of a retiring, modest, unselfish, and deeply religious nature, his earnest enthusiasm served not only to create in all a sincere regard for him, but to make him beloved by those who were privileged, whether as teachers or students, to become intimately acquainted with him. At all times an ardent student, an untiring investigator, a successful teacher, and a contributor in so great a variety of ways to the advancement of science, by his early death an already brilliant career has been deplorably cut short and a vacancy created in the ranks of scientific men in this country which must long remain unfilled.

H. E. R.
P. P. B.

NOTES.

THE well-known writer on vegetable palæontology, Prof. E. Weiss, of Berlin, died on July 5 last.

THE Swedish residents of Chicago have subscribed for a statue of Linnæus, which will shortly be erected in the Lincoln Park in that city.

DR. A. MÖLLER, of Berlin, has established, at Blumenau in the State of S. Catharina in South Brazil, with the assistance of the Prussian Academy of Sciences, a botanical laboratory, where, during the next two years, he will pursue Brefeld's method of the artificial culture of the higher and lower filamentous Fungi. He will be glad to receive suggestions from botanists interested in the subject

THE Congress of the United States has granted the sum of 40,000 dollars, to be employed, exclusively of salaries, in the prosecution of botanical work by the Division of Botany of the Department of Agriculture. The Section of Vegetable Pathology has now been made a distinct division, and is at present especially concerned in investigating the grape-vine disease which is spreading rapidly in California.

THERE has recently been added to the marine collection at the Brighton Aquarium a specimen of the manatee, or "sea cow." The specimen has been imported from Trinidad, and was brought from Liverpool by Mr. Wells, the marine superintendent, under whose careful supervision it was safely transferred to its new home in the Brighton Aquarium. The tank in which it has been placed has been specially fitted with heating apparatus, it being necessary to keep the temperature to between 70° and 80°. The manatee is 4 feet 6 inches in length, and feeds principally upon lettuce, of which it consumes large quantities.

THE Lords of the Committee of Council on Education have just sanctioned under Clause 8 of the Technical Instruction Act, 1889, a resolution passed on August 12, 1890, by the Council of the city of Worcester. This resolution consisted in making grants, under the powers conferred upon them by the Act, to certain institutions in Worcester for the promotion of technical instruction, and it was the opinion of the Council that such a form of instruction is required by the circumstances of the district. The instruction is to be given in the following subjects, which are not included in the branches already recognized by the Science and Art Department: French, German, typewriting, shorthand, bookkeeping, commercial geography, commercial arithmetic, and cookery.

THE *Photographic News* contains an account of the eleventh annual Convention of the Photographers' Association of America, which proved a great success. The chief part of the programme was the unveiling of the monument to Daguerre at the city of Washington. The work was after the design of Scott Hartley, and is stated to be of a beautiful unique design, and worthy of the admiration of every photographer in America. The sessions, owing to the kindness of the United States officials, were held in the National Museum, and under the very able management of the executive officers an excellent programme was provided and carried out successfully. There was an unusually large number of papers presented, and the discussions were entered into by the members in the most hearty and satisfactory manner. Among other articles are those by Dr. H. W. Vogel on photography in Germany, and by Colonel J. Waterhouse on the reversal of the negative photographic image by thio-carbamides.

THE last two numbers of *Cosmos* contain some very interesting information on various topics. Some new discoveries have been made at Pompeii, near the Stabiana Gate, and a description is given of them. Three bodies were found, two being those of men and the third that of a woman. Not far from the resting place of these bodies was found the trunk of a tree, 3 metres in height, and measuring 40 centimetres in diameter. This tree, together with its fruits that were found with it, have been examined by the Professor of Botany, M. Pasquale, who finds in it a variety of *Laurus nobilis*. By means of the fruits, since they come to maturity in the autumn, he concludes that the eruption did not take place in August but in November.

THE current number of *La Nature* contains an interesting account of the ceremony of unveiling the new statue of Gay-Lussac at Limoges. In the name of the Academy of Sciences, M. P. P. Dehérain gave a long discourse on the life and works of this great man, extracts from which are given. Prince Roland Bonaparte gives a description of the race of Somalis, some of which are at present in the Acclimatization Gardens of Paris, and which form a most curious ethnographical exhibition. The article is written from observations of the author and from other sources, and deals with the country, food, habits, dress, &c., of these people who inhabit that country, "si affreux et si désolé."

IT was observed a short time ago by Dr. Kremser, that the curve of mortality in North Germany lagged about two months behind that of the variability of temperature. An inquiry into this matter in the case of Budapesth has been lately made by Dr. Hegyfoky, taking the nine years 1873-81. Comparing the months, he failed to make out a certain connection. But taking into account other meteorological elements besides temperature, and reckoning by seasons, he found the variability of weather in the different seasons to give the following order from maximum to minimum: winter, spring, autumn, summer. As regards mortality, the order was: spring, summer, winter, autumn. Thus it appears there is a displacement of three months. If a connection of the kind referred to really exists between weather and mortality, the effect, mortality, must appear somewhat later than the cause, variation of weather.

THE *National Review* for September contains an article on the progress of weather study, by H. Harries. The subject dealt with refers chiefly to the wind, and the author traces the history of the development of the law of storms and of the practical application to weather prediction. He points to the useful work of the Meteorological Department under Admiral FitzRoy in collecting synchronous observations of the *Royal Charter* storm of October 1859. The charts then published, although too limited in their area, threw much light on the movements of the atmosphere and formed a most important step in the right direction. The later investigations of the Meteorological Council of the United States Office, and of the *Deutsche Seewarte*, &c., have contributed greatly to increase our knowledge, and to improve the accuracy of weather forecasts and it is by such synchronous discussions, and by taking advantage of the reports from rapid steam vessels, that we must hope for an extension of our knowledge in the future.

MR. E. NEVILL, the Government Chemist at Natal, in his last report to the Colonial Secretary, notes that valuable deposits of argentiferous galeno of copper and of bismuth exist in the colony, and of such rich nature that they could be profitably exported in bulk. In both Alexandra and Umvoti Counties deposits of silver-bearing lead ore have been found, containing from ten to fifteen pounds worth of silver per ton of lead ore. Saltpetre has been found so rich as to be worth more than three times as much as the best Peruvian deposits. Plumbago, asbestos, and the mineral phosphates appear to be of inferior quality. Several calcareous formations have been examined, which are likely, under proper treatment, to yield good hydraulic cement.

SOME chemical reactions can be started or accelerated by sunlight, and an increased effect is to be expected where the rays are concentrated by a lens or concave mirror. Herr Brühl has recently described (in the *Berichte*) experiments made in this way, in production of zinc ethyl from zinc and ethyl iodide (a reaction difficult to start). The retort, containing zinc-filings and several hundred grammes of ethyl iodide, was placed at the focus of a concave mirror, about a foot in diameter, receiving the sun's rays. The reaction soon began, and grew so vigorous that cooling was necessary. In a quarter of an hour all the ethyl iodide was consumed, and through the subsequent distillation in an oil-bath, a good yield of zinc ethyl was had. This radiation process, it is suggested, might be variously useful in actions on halogen-compounds, which tend to be disaggregated by sunlight. A lens, owing to the athermanous property of glass, would be less powerful.

MR. A. MCADIE, Fellow of Clark University, U.S., has forwarded us his prize essay on tornadoes, reprinted from the *American Meteorological Journal* for August. After a discussion of the state of our knowledge of storms of this character, the possibility and practicability of predicting them is considered. It is suggested that, since the barometric movement is too sluggish and the thermometric indications too much masked to be serviceable, the electrometer might be better adapted to give notice and warning of the proximity of violent whirlings in the air and detect those which would otherwise pass unheeded. A careful study of cloud movement is also suggested, as a method promising much in the way of obtaining knowledge bearing on the occurrence of tornadoes.

THE Report of Dr. Eitel, Inspector of Schools in Hong Kong, for the past year, contains some interesting details. The total number of educational institutions of all descriptions, known to have been at work in the colony of Hong Kong during the year 1889, amounts to 211 schools, with a grand total of 9681 scholars under instruction. More than three-fourths of the whole number of scholars, viz. 7659, attended schools (106 in number) subject to Government supervision, and either established or aided by the Government. The remainder, with 2022 scholars, are private institutions, entirely independent of Government supervision and receiving no aid from public funds. The total number of schools subject to direct supervision and annual examination by the Inspector of Schools amounted, in 1889, to 104, as compared with 50 in 1879, and 19 in 1869. The total number of scholars enrolled in this same class of schools during 1889 amounted to 7107, as compared with 3460 in 1879, and 942 in 1869. In other words, there has been an increase of 31 schools and 2518 scholars during the ten years from 1869 to 1879, and an increase of 54 schools and 3647 scholars during the ten years from 1879 to 1889. It would seem, therefore, that the decennial increase of schools and scholars during the last twenty years has shown a tendency to keep up with the progressive increase of population. Comparing the statistics of individual years, the number of schools under supervision and examination by the Inspector of Schools rose from 94 in 1887 and 97 in 1888 to 104 in 1889, whilst the number of scholars under instruction in these same schools rose from 5974 in 1887 and 6258 in 1888 to 7107 in 1889. There is, therefore, a steady annual increase during the last three years, progressing from an increase of 284 scholars in 1888 to an increase of 849 in 1889. The expenses incurred by the Government during the year 1889, on account of education in general, amounted, exclusive of the cost of new school buildings, to a total of $53,901.

IN *Science* reference is made to a question which may interest many of our readers, "Should beer be drunk out of a glass?" Dr. Schultze claims to have established, by a very extended series of experiments, that beer, by as little as five minutes' standing in any glass, even when cold and in the dark, will be materially affected both in taste and odour. By making trial tests on some one hundred persons he sustains his claims. The change is due, as he thinks, to the slight solubility of the glass substance in the beer. Lead is used in the manufacture of glass, making it more easy to manipulate, and from experiments with glass obtained from the leading sources of supply, he determined that one cubic centimetre of beer, by five minutes' standing in glass, dissolved 6–26 ten-millionths of a milligram of the glass substance containg 0–48 thousand-millionths of a milligram of lead oxide. It is this small quantity of glass substance that affects the taste of the beer, and if it contains lead, renders it objectionable for sanitary reasons. By further experiments with vessels of different substances, he comes to the conclusion that gold-lined silver mugs are the best, and he ranks covered salt-glazed stone mugs as good.

THE United States Consul at Hanover, in a recent report refers to afforestation in that State, where, he says, there were formerly rich tracts of forests. These, in consequence of wars, were reduced to desolate wastes, and remained so until the first decades of the present century—particularly those districts between Hamburg and Hanover which are known by the name of Luneburger Haide. Another reason for the devastation was mismanagement, such as division of common forests, by which they were dispersed and fell into the hands of people with small means, and thus were doomed to neglect and destruction. The celebrated Burkhardt was appointed Director of the Forest Department in 1850, and under him part of the Luneburger Haide, as well as other tracts growing more and more desert by the encroachments of sand, have been wooded with great pains and trouble. To prevent the increase of sandy deserts those tracts were at first planted with fir-trees. After a number of years these were cleared, and beech and other trees substituted. How much the forests have been enlarged in this manner will appear by the fact that the wooded surface amounted in the year 1850 to 1,217,625 acres, and in 1885 to 1,551,900 acres. The Government granted large sums for the purchase of land unfit for cultivation to be turned into forest tracts, and is now intent on uniting again those formerly scattered wooded parts into one single tract. In the same way the Klosterkammer (Administration of cloister funds) purchase extensive stretches of soil. Municipalities, communities, and even private individuals who are inclined to establish forests and manage them rationally, will receive loans at 2 per cent. from the Provincial Government, to be reimbursed yearly by small instalments; single subsidies also are granted for converting large wastes into forest grounds. The Government employed vagabonds, tramps, and prisoners not of a dangerous character, for forest culture. In this manner about 9000 acres were planted with trees by those troublesome classes within the years 1876 to 1888. Moreover, communities as well as private individuals have turned about 14,000 acres into forest grounds within the same period by means of subsidies afforded by the Provincial Government, and various towns have laboured to preserve and plant forests in their vicinity for purposes of health, recreation, and incidentally of profit also.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♂) from India, presented by Mr. A. S. Keys; a Brazilian Tree-Porcupine (*Sphingurus prehensilis*) from Trinidad, presented by Mr. J. N. Kilner; two Vulpine Phalangers (*Phalangista vulpina* ♂ ♀) from Australia, presented by Mr. J. G. Mackie; two Pucheran's Guinea Fowls (*Numida pucherani*) from East Africa, presented by Mr. Keith Anstruther; a Silver Pheasant (*Euplocamus nycthemerus* ♀) from China, presented by Mr. E. W. H. Blagg; two Wheatears (*Saxicola œnanthe*), a Stonechat (*Pratincola rubicola*), a Whitethroat (*Sylvia cinerea*), British, presented by Mr. J. Young, F.Z.S.; an Owen's Apteryx (*Apteryx oweni*) from New Zealand, presented by Capt. E. A. Findlay, R.N.R., R.M.S. *Ruapehu*; a Blue and Yellow Macaw (*Ara ararauna*) from South America, presented by Mr. Luxmore Marshall; a Blue-eyed Cockatoo (*Cacatua ophthalmica*) from New Britain, presented by Mrs. R. E. Anson; a Guillemot (*Lomvia troile*), British, presented by Mrs. Forbes; two Common Gulls (*Larus canus*), a Black-headed Gull (*Larus ridibundus*), British, presented by Mr. A. C. Howard; a Lion (*Felis leo* ♂) from Sokoto, West Africa, deposited; a Common Bee-eater (*Merops apiaster*), European, a Green-headed Tanager (*Calliste tricolor*) from Brazil, purchased; three Garden Dormice (*Myoxus quercinus*) from Vosges, France, received in exchange; two Viscachas (*Lagostomus trichodactylus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on September 25 = 22h. 18m. 40s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 4815	—	—	22 32 1	+33 49
(2) 615 Birm.	6	Yellowish-red.	22 34 18	+56 13
(3) B.A.C. 7954	4	Yellowish-red.	22 43 46	−14 4
(4) ζ Aquarii...	3	White.	22 23 12	− 0 35
(5) η Aquarii	4	White.	22 29 42	− 0 41
(6) 251 Schj.	8	Very red.	21 38 43	+37 31
(7) T Herculis	Var.	Reddish.	18 4 56	+31 0

Remarks.

(1) According to the observations of Huggin and D'Arrest, this nebula has a continuous spectrum, but further observations for "irregularities" or bright flutings should be made. The nebula is described as "Bright; pretty large; pretty much elongated in the direction 160°; suddenly much brighter in the middle."

(2) Dunér compares the spectrum of this star of Group II. with that of α Herculis, and states that "it is one of the finest in the northern sky." The bands 2–9, including 6, are very wide and dark, and the spectrum is one which may be advantageously studied. Light-curves of spectra of this type are valuable, as they show the relative extent of carbon radiation, and therefore serve as a cross check in the classification which is made on other grounds.

(3) The spectrum of this star is one of Group II., in which bands 2, 3, and 7 are dark but not very wide, and bands 4, 5, and 8 are feeble and narrow. Dunér thinks it almost intermediate between Group II. and Group III., but in this he is probably mistaken, as the description agrees almost exactly with that of 75 Cygni (see p. 511), which turns out to belong to an early and not a late species of the group. In that case the bright carbon flutings are predominant, and it will probably be found that this applies also to the star in question. Here, again, a light-curve of the spectrum compared with that of a star like (2) should emphasize this point.

(4) This star has a spectrum which is almost Group IV., the hydrogen lines being considerably broad, but, at the same time, *b* and D are seen without much difficulty. Its proper place on the temperature curve is therefore the last stage of Group III. It may be remarked that with the same thickness of F in a star of Group V., the metallic lines would not be so prominent. One need only compare Aldebaran and Capella to see this difference in the intensities of the metallic lines in Groups III. and V.

(5) A star of Group IV.

(6) In the spectrum of this star of Group VI. no secondary bands were seen with certainty by Dunér, and although the green and yellow zones are very bright, the blue light is very feeble. It seems as if in some of these stars there is more continuous absorption than in others, and comparative light-curves of the spectra of stars of the group might throw light upon this point. This again would probably enable us to determine the relative temperatures of the different stars. The intensity of the blue zone certainly does not depend altogether upon magnitude.

(7) The approaching maximum of this variable (October 4), will offer another opportunity of determining the character of its spectrum. It is much to be regretted that so many variables have as yet unknown spectra, and the sooner they are observed the better. T Herculis has a period of about 165 days, and ranges from 6·9–8·3 at maximum to 11·4–12·7 at minimum (Gore). A. FOWLER.

SOLAR ACTIVITY FROM JANUARY TO JUNE 1890.—Prof. Tacchini has just presented to the Paris Academy of Sciences a note on the distribution in latitude of solar phenomena observed by him during the first half of this year (*Comptes rendus*, September 15). Hydrogen prominences have been more frequent in the southern hemisphere than in the northern, and reached a maximum of frequency in the zone included between the latitudes 40°–50°. This was also the case in 1889 (*Comptes rendus*, May 5, 1890). During the second quarter of this year prominences have been observed very near to the poles, which indicates that solar activity is on the increase. Faculæ show maxima of occurrence at the same distance from the equator in both hemispheres, viz. 20°–30°. The maximum frequency in the northern hemisphere is more marked, however, than in the southern. The distribution of groups of spots is the same as that of faculæ, hence Prof. Tacchini concludes that we have reached a period of change in the distribution in latitude of solar phenomena; for whilst prominences have maintained a predominance in the southern hemisphere, faculæ and spots have been more frequent in the northern. The absolute number of groups of spots during the second quarter of this year was greater than that of the first quarter, thus indicating that the minimum period has definitely passed.

THE TELLURIC SPECTRUM.—In the current number of *L'Astronomie* M. Janssen gives a short account of his work in Algeria on the telluric spectrum. The object of the expedition was to photograph the solar spectrum on isochromatic plates when the sun was respectively on the meridian and horizon. By the use of such plates, having maxima of sensibility at the less refrangible end of the spectrum, the increase in intensity of the most important telluric lines, which accompanied a decrease in the sun's altitude, may be strikingly demonstrated. The observations were made from a small fort near Biskra, situated on the edge of the Sahara, and having an uninterrupted view towards the south. The solar spectrum was obtained by means of a Rowland's grating, and many photographs were taken during the three months of observation. Their discussion is not yet completed, but M. Janssen notes that without the purity of the sky at the place of observation and the continuance of fine weather it would have been impossible to obtain any useful results. An excursion was made to Tuggurt in order to study the solar spectrum from one of the driest places on our globe. Some photographic observations of mirages were also made at the same time, and are said to throw much light on the nature of the conditions necessary for the production of these singular phenomena.

THE PERSEID METEORS.—In *Comptes rendus* for September 15, Prof. Denza gives an account of the observations made in Italy from August 9 to 11 under the direction of the Italian Association for the Observation of Meteors. From the results obtained at the thirty stations it is concluded:—

(1) The number of luminous meteors, especially on August 11 and 12, was greater than in preceding years, and has relatively attained a maximum. This appears to prove that the earth has cut through a condensation in the meteoritic ring.

(2) The meteoritic shower, which formerly began on August 10, appears to have suffered a retardation, and now begins on August 11.

(3) The following are the numbers of meteors observed at some of the stations: Vatican Observatory, 1971; Florence, 1749; Aprica, 1740; Gaeta, 1305; San Martino in Pensili, 1276; Moncalieri, 1036.

(4) The radiant of the principal shower was found to have the same position between Perseus and Cassiopeia as has previously been noted.

(5) Other radiants were also observed, and notably in Ursa Major and Ursa Minor, Cygnus and Andromeda.

(6) Most of the meteors seen had the yellow colour characteristic of this swarm.

(7) The shower was a remarkable one this year, not only because of the great number of meteors, but also because of their large size.

NATAL OBSERVATORY.—From the annual report of the Government Astronomer of this Observatory for 1889 it appears that the principal work in progress is a comparison of the declinations deduced from observations made at Observatories in the northern and southern hemispheres by a comparison by Talco's method of the zenith distances of northern stars and circumpolars both above and below the pole. Some important results have also been obtained from an investigation into the present theory of lunar motion. The meteorological observations made during 1889 have been tabulated, and will be found useful.

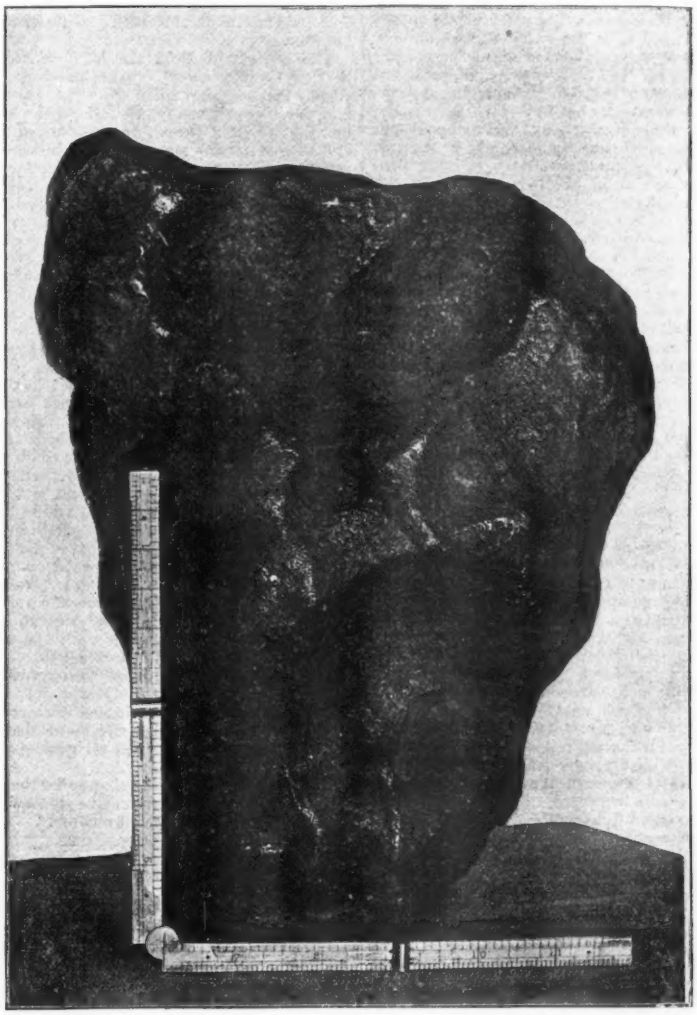
THE NARRABURRA METEOR.

THE Narraburra meteor was found in the year 1854, by Mr. O'Brien, in lat. 34° 10′ S., long. 147° 43′ E., which is a point on the Narraburra Creek about 12 miles east of Temora. When

found, it was on a hard and stony surface, but I have been unable to obtain any other particulars, as the finder has long since passed away to the majority.

Mr. O'Brien gave the meteor to Mr. Patrick Harrold, of Mount Hope, near Cootamundra, and it has been in his keeping ever since; until, on March 30, 1890, he was induced by Mr. William R. Eury, Inspector under the State Children's Relief Branch, to send it to me. Mr. Eury, as soon as he saw the meteor, pointed out to Mr. Harrold the great scientific interest attaching to it, and that undoubtedly the proper place for it was in the Observatory, where a collection of these so-called shooting-stars is being made, and upon this, Mr. Harrold sent it to me. I am very much indebted to both of these gentlemen for enriching the Observatory collection by this most interesting specimen of a metallic meteor. Our museum for meteors now contains six.

In appearance this meteor is like rusty iron, and it has a very irregular outline, which seems to have resulted from the oxidation or solution of rounded masses, which had solidified with the iron, and upon removal formed cavities. In size it measures 11 inches × 7½ inches. Two of these are so placed that they look like the orbits in an ox's skull, a suggestion borne out by



the general outline, which is not unlike the bone in question. In one place a hole nearly 1 inch in diameter and 1½ inch deep, has been made straight into the solid iron, and there seems to be little doubt that, when the iron originally cooled down from its gaseous state, it did so in the presence of these rounded and symmetrical masses, which impressed their form on the plastic iron as it solidified. These, as I have already suggested, have no doubt been removed since they reached the earth's atmosphere.

A meteor which fell in New England in November last was seen to have a spiral motion, emitting steam or smoke in jets. Looking at the holes in this meteor, one can see at once that if, when it reached the atmosphere, they were charged with some substance that would burn freely in the oxygen of the air, this solid mass of iron would have twisted about under the influence of the many gas-jets from the burning masses in its sides.

I find its specific gravity is 7·57 and its weight is 71 pounds (70 pounds 14 ounces). Meteoric iron is, I think, never quite pure, and masses of it vary very considerably in specific gravity. Taking five at random which fell in different parts of the earth, it varies in them from 7·38 to 7·82, and the mean happens to be 7·62, almost exactly the same as the one before us.

This meteor has not been analyzed yet.

July 26 H. C. RUSSELL.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE thirty-ninth annual meeting of this body was held on August 20–26 at Indianapolis, which is the capital and largest city of the State of Indiana, and is the largest inland city of the United States, being a railroad centre without navigable water of any kind, and having, with its suburbs, a population of about 140,000.

Near the city is located the greatest region of natural gas in the world. The manufacturing business of this whole region has received a wonderful stimulus from the discovery of natural gas, which has caused a rapid increase in population and manufacturing within the past three years. The gas is found in the Trenton limestone at a depth of nearly a thousand feet over a large area north and east of the city, and, besides being used *in situ*, is brought to the city in pipes for use there, where it has displaced other fuel in the large factories. One of the most instructive object-lessons the Association has ever had was the excursion on Saturday through this gas belt, stopping at Noblesville (whence the supply for Indianopolis is drawn), Kokomo, Marion, Muncie, and Anderson. At the latter place a remarkable exhibition was made of gas forced through the river and ignited upon the surface. President Goodale warned the citizens in an address of the necessity of economizing this resource, since it is not inexhaustible.

The sessions of the Association were held in the new Capitol, a fine building completed only two or three years ago at the cost of about 2,000,000 dollars, and decidedly the most sumptuous quarters ever offered to the Association, being also spacious enough to accommodate all the eight Sections under one roof.

A number of affiliated associations meet at or about the time of the principal one. Of these the Society for the Promotion of Agricultural Science, and the Society of American Geologists preceded the main meeting, while the Botanical, Entomological, and, this year for the first time, the Ornithological Club, met at intervals between meetings of the parent Association.

On Wednesday morning the retiring president, Prof. T. C. Mendenhall, called the Association to order, and resigned the chair to Prof. George L. Goodale, President-Elect. The morning was devoted to addresses of welcome and responses, and to the organization of the several sections. Among the speakers were Mayor Sullivan and Lieutenant-Governor Chase. An invitation was received from the Australasian Association for the Advancement of Science to attend the meeting at Christ Church, New Zealand, in January 1891, and President Goodale was deputed, and will attend as a delegate.

In the afternoon the eight Vice-Presidents read their several annual addresses before their respective Sections. These addresses were generally ably written.

Section A (Mathematics and Astronomy) was addressed by Prof. S. C. Chandler, of Harvard, on the variable stars. The number of these discernible with an ordinary field-glass is two thousand, while our largest telescopes reveal, perhaps, hundreds of thousands. The cycle of change, commonly called the period, ranges from less than eight hours in the wonderful variable recently found by Paul, up to two years. Between these limits is a highly significant deviation from uniformity of distribution. At least five-sixths of the variables are reddish, and the redness of the variable stars is, in general, a function of the length of their period of light variation. The redder the tint, the longer the period. An examination of fluctuations in brightness, or light curves, enables us to distinguish a number of types, of which the most remarkable is that of Algol. The cause of variability is still problematic, except for the ten stars of the Algol type, which seem to be explained by the theory of an occulting satellite, somewhat modified however. For the other types we may perhaps seek an explanation in certain consequences of rotation of the stars upon their axes, or by introducing modifying suppositions of unequally illuminated surfaces, irregular forms, tidal action upon light-absorbing atmospheres, spontaneous and intermittent explosions, meteor swarms, and the like.

Section B (Physics) was addressed by Prof. Cleveland, Abbé of Washington, colloquially designated throughout the United States "Old Probs," for the reason that he is in charge of the weather bureau, and makes up the daily weather report, with indications, formerly called probabilities. His theme was terrestrial physics. There are two kinds of physics—molecular and terrestrial. The latter he names, following the German nomenclature, geo-physics. It relates to the earth as a whole, including all phenomena relating to earthquakes, volcanoes, gravitation, and the variations in its intensity on land and sea, mountain, plain, and valley, magnetism of the earth, tidal motion and tidal stress of the earth's crust as well as of the ocean, and in general the study of the entire interior of the earth, of the earth's crust, both land and water, meteorology, auroras, &c. He deplores the lack of laboratories for such researches, and deems a good geo-physical laboratory a great desideratum. He urges that some such institution should be founded and endowed, rather than to continue the founding of laboratories for research in chemistry or molecular physics of which so many are already in existence, or the establishment and endowment of universities to teach only what is already known.

The address of Prof. R. B. Warder, of Washington, to Section C (Chemistry), on geometrical isomerism, was decidedly the most abstruse of the series, but to one able to follow him, it was of unusual interest, giving the latest results of study into the subject of the relative positions of atoms in a molecule, including a careful study of the right-handed and left-handed carbon molecules. Most of this material is very recent, the prominent workers, such as Wislicenus and Wunderlich, having made more progress within two or three years than in any previous period. Besides the speculative interest of these studies they have a very important practical application in the physiological and pathological action of isomers, many of which, while identical in chemical constitution, affect living organisms very differently, whether administered as food or as medicine.

Prof. James E. Denton, of Hoboken, addressed Section D (Mechanical Science and Engineering) on mechanical tests of lubricants. Experiments to determine the co-efficient of friction between lubricated rubbing surfaces have been prosecuted for two hundred years, and have resulted in the existence of many forms of satisfactory apparatus for such measurement, which are now known as oil-testing machines. The overheating of bearings is due, however, to accidental abrasion of rubbing surfaces, which generates an intense heat at some points, and tends to vaporize some oils more than others. Oil-testing machines are inadequate to reveal these differences, and moreover the supply of oil is artificially abundant, instead of feeding through practical forms of oil-cups. It is concluded, therefore, that each oil must be tested with a series of conditions of the rubbing surfaces, and practical feeding devices which involve opportunities for abrasion and overheating. Explanation was given of the paradoxical fact that overheating is often remedied by supplying sand or emery to bearings. The sand grains make grooves around the wearing parts, and as a result the oil is uniformly distributed, and the hot-box cools down to the limit of safety.

Prof. John C. Branner, State Geologist of Arkansas, addressed Section E (Geology and Geography) on relations of the state and the national geological surveys to each other. He thus recapitulates the benefits to be derived from voluntary cordial co-operation between all geologists and all geological organizations in this country.

"(1) Geologic research being under the nominal direction of the leading investigators would be so conducted as to be of the greatest utility to the greatest number.

"(2) When a piece of work was done by one it would be done for all, and duplication by state surveys and by individuals, and the consequent waste of energy, time, and money would cease.

"(3) The functions and fields of official organizations being better defined, state and national surveys and individuals could so direct their efforts as to serve the purposes of others without neglecting their own immediate aims, and without infringing upon each other's ground.

"(4) National and state surveys would be strengthened, and local organizations and individual effort encouraged.

"(5) It would give us a better geologic literature, better instruction, better geologists, and more thorough specialists.

"(6) And finally, we trust it would put a stop to those oracles of science who are so ready to prophesy in its name."

Dr. Charles S. Minot, of Boston, addressed Section F (Biology) on certain phenomena of growing old. The loss of vital power commences from birth; the older an organism is the more time it takes to produce a given change, and this indicates a progressive loss of vitality. Anatomical peculiarities can be found correlated with this progressive loss of vitality. Considering in detail the various tissues of the body in the order of

their development, in each of the principal tissues and organs of inner, middle and outer layer of the body, the cells composing them show the same peculiarity, namely, that in their young condition they contain only a small amount of protoplasm, and in the adult condition a very much larger amount, so that the proportion of protoplasm to nucleus increases with the age of the organism. The conclusion is that development of protoplasm is associated with loss of vitality. So that instead of speaking of protoplasm as the physical basis of life, we might term it the physical basis of advancing decrepitude, or in other words, the physical basis of death. The reverse development is seen in generation, where the first process which the fecundated ovum undergoes is segmentation into numerous nuclei, with attendant decrease in the proportion of protoplasm to nucleus, and precisely the same phenomenon is noted in animals which multiply by fissure, the tissues at the point of fissure becoming greatly segmented.

Dr. Frank Baker, of Washington, addressed Section H (Anthropology) on the ascent of man, in which he traced with much detail the modifications which the body has undergone in ages of development, the more striking modifications being those connected with the limbs, the change from quadrupedal to erect posture and the segmentation of the body, and indications of change being left as vestigial organs. The erect position is gradually acquired, and the difficulty that an infant experiences in learning to walk erect is strong evidence that it is an accomplishment acquired by the race late in its history. The human body gives evidence of a previous semi-erect position. The special changes of structure which secure the erect position are less marked in children and in the lower races. In the course of evolution of these changes, there is a period of struggle before the body becomes thoroughly adapted to them. Such struggle is still going on, the adaptation being far from complete. Hence the liability of man to certain deformities and diseases, to which quadrupeds are not so much disposed. It is in just this line that is to be found the explanation of the greater difficulty and dangers of parturition in the human family, and of the fact that woman in her entire organism has suffered more than man in the upward struggle. The increased influence of gravity also explains the greater tendency to certain disturbances of the circulatory organs. Study of the bony skeleton gives, in man, evidence of his relationship, in origin to the lower animals, as in the persistence of relics of ribs, and in unmistakable signs that the skull is composed of segmented pieces like the vertebræ. The evidence of such relationship has come, and is coming from all sides, from the study of comparative brain weight and structure, of the facial angle, the face bones and teeth, with their resulting changes in expression from brute or brutal man to the highest types, in which the brain shows its rulership in the countenance.

Prof. J. R. Dodge, of Washington, addressed Section I (Economic Science and Statistics) on the standard of living in America. Prof. Dodge is chief of the agricultural bureau of statistics of the United States, and his report of the condition of growing crops on the 10th of every month is always eagerly awaited, and has a great effect on market prices of agricultural produce of all kinds. The American standard of living is the highest known. To maintain it, wages are and should remain high. Production is not thereby diminished because of the brain power of the American people and our utilization of labour-saving machinery, so that in many articles exportation increases enormously despite high wages. Our woods are tougher than those of Europe, and we would not accept European tools if given to us.

His most important conclusions are: The question arises, Shall the present standard of living be maintained? It is a point upon which hangs "the future education, enterprise, independence, and prosperity of the people" of the United States. It depends on the industry of the producing classes, and wisdom in the distribution of their labour for a production that shall meet their wants. If idleness shall be encouraged, production limited, importation enlarged, and dependence on foreign countries fostered, wages will be reduced, and the ability to purchase as well as the volume of production will decline. If the advice of public and private teachers of repressive economy to buy everything abroad, and sit down in the enjoyment of the luxury of idleness at home, shall become the law of the land, short rations will follow, and high prices will only be abated by the inability of our people to purchase for consumption.

Unless the largest variety of production shall be encouraged, and the highest skill shall be stimulated in the endeavour to meet all the wants of our people by the results of our own labour, it will be impossible for us to have a surplus for export. It is a matter of time, of determined effort, of high endeavour to render high wages consistent with large exportations of surplus, but the future will accomplish it, if the present scale of living and rate of wages of the American people shall be maintained.

Wednesday evening was taken up with the address of the retiring president, Prof. T. C. Mendenhall, chief of the United States Geodetic and Coast Survey, who spoke on the relation between men of science and the community. He began by calling attention to the fact that this association is the outgrowth of the Association of American Geologists and Naturalists organized just fifty years ago. He spoke of the duty assigned the retiring president to present an address as giving an opportunity to dismiss the relationship between members of the Association and the general public whose interest is often born of curiosity rather than intelligent appreciation. The meetings of this Association have been the means of disseminating proper methods of investigation and study throughout the land. He considered various elements of weakness in scientific men such as assumption of superior knowledge in lines of investigation outside of their own specialties, lack of a proper amount of utilitarianism, as well as lack of interest in political affairs, contrasting this spirit with the distinguished service rendered to mankind by such scientific men as Newton, Watt, and Franklin. The ideal of duty which ought to be present in the mind of every man of science may well be higher than that growing out of mere selfish pleasure in the acquisition and possession of knowledge.

The remaining days of the session—Thursday, Friday, Monday and Tuesday—were devoted to general business and the reading of papers in the sections. On Friday evening Dr. H. C. Hovey lectured on Mammoth, Marengo, and Wyandotte caves, and on Monday evening Prof. C. Leo Mees lectured on electricity.

The general business included an appropriation of 250 dollars to Prof. E. W. Morley for the further prosecution of his researches in the velocity of light in a magnetic field; resolution of thanks to two Brazilian gentlemen for removing to the museum at Rio the largest meteor ever found, weighing five tons; resolution requesting Congress to provide fire-proof quarters for the botanical collection at Washington, and another urging protection of the forests; resolution favouring the use of the metric system at Custom houses in the United States.

It was decided to hold the next annual meeting at Washington, and invitations were sent to other governments on the American continent to send delegates, thus giving to this meeting, which is the only one held at Washington in recent times, an international character.

The Association adopted the report of the committee of anatomical nomenclature, which recommends the following changes, with special reference to the brain: "That the adjectives dorsal and ventral be employed in place of posterior and anterior, as commonly used in human anatomy; and, in place of upper and lower as sometimes used in comparative anatomy; that the cornua of the spinal cord and spinal nerve roots be designated dorsal and ventral rather than posterior and anterior; that the costiferous vertebræ be called thoracic rather than dorsal; that the hippocampus minor be called calcar; that the hippocampus major be called hippocampus; the pons variolii, pons; the insula Reilii, insula; pia mater, pia; dura mater, dura."

Two hundred and fifty-nine papers were read, of which the largest number, fifty-one, were in the section of physics, and the next largest, forty-eight, in biology. It is difficult to attempt a selection without doing injustice, but a few of the papers deserve mention, while perhaps others, equally meritorious, may be overlooked. Prof. Cleveland Abbé read papers by himself on kinematic methods of determining the altitudes and motion of the clouds, and, by Frank N. Bigelow, on further study of the solar corona, and on terrestrial magnetism. The corona is deemed to consist of matter streaming out from the sun in zones about 32° distant from the poles, and falling back into the region of sun-spots, which are, probably, thus caused. It is regarded as similar to the earth's aurora, though of denser matter.

Prof. T. C. Mendenhall, in his paper on the use of the magnetograph as a seismoscope, showed that earthquakes are caused by the tidal stress of sun and moon upon the earth's

crust, and are accompanied by magnetic currents which serve as indices of their approach.

Prof. E. W. Morley's report on the velocity of light in a magnetic field shows an increase in velocity in such a field amounting to seven parts in one thousand million. These investigations are to be continued.

Prof. Morley also read a paper on the determination of the volumetric composition of water, and one on the ratio of the density of oxygen and hydrogen. In twenty determinations the minimum value of combination in water was 2·0005, the maximum was 2·00047, mean 2·00023, with a probable error of one part in 30,000. The value two to one, which every schoolboy learned is the ratio of hydrogen and oxygen in water, must be increased about one nine-thousandth. In two determinations of density, Morley reaches the same result as Rayleigh, viz. 15,884, giving 15,882 as the atomic weight of oxygen. Prof. W. A. Noyes read a paper on the atomic weight of oxygen, giving the results of four series of six determinations with apparatus devised by himself. The value found is 15,896, or about seven one-hundredths less than the usually accepted one.

The series of papers on distribution of North American plants, prepared on topics assigned last year, was pronounced by the presiding officer the most remarkable ever presented to the biological section. They were on the distribution of the North American umbelliferæ, by John M. Coulter; the distribution of hepaticæ of North America, by Lucien M. Underwood; geographical distribution of North American grasses, by W. J. Beal; geographical distribution of North American cornaceæ, by John M. Coulter; and the general distribution of North American plants, by N. L. Bulton. The following assignments were made for next year:—The absorption of gases, J. C. Arthur; the aëration of aquatic plants, W. P. Wilson; the absorption of fluids, L. H. Pammel; the movement of fluids in plants, W. J. Beal; transpiration, C. E. Bessey.

The exhibition of apparatus included some delicate seismoscopes and seismometers. Prof. Mendenhall exhibited some of the metric standards recently distributed by the International Congress, in the manufacture of which to distribute to all nations, two-thirds of all the iridium in the world was used. Prof. W. A. Rogers exhibited a precision screw 8 feet long, with a variation of only 1/8000 of an inch in its entire length.

Officers elected for the Washington meeting were: President, Albert B. Prescott, of Ann Arbor, Mich.; Vice-presidents, Section A, E. W. Hyde, of Cincinnati, O.; Section B, F. E. Nipher, St. Louis, Mo.; Section C, R. C. Kedzie, Agricultural College, Mich.; Section D, Thomas Gray, Oene Haute, Ind.; Section E, J. J. Stevenson, New York; Section F, J. M. Coulter, Crawfordeville, Ind.; Section H, Joseph Jastrow, Madison, Wis.; Section I, Edmund J. James, Philadelphia, Pa.; Permanent Secretary, F. W. Putnam, Cambridge, Mass. (holds over); General Secretary, Harvey W. Wiley, Washington, D.C.; Secretary of the Council, Amos W. Butler, Brookville, Ind.; Treasurer, William Lilly, Manch Chunk. Secretaries of the sections: Section A, E. D. Preston, Washington, D.C.; Section B, A. McFarlane, Austin, Texas; Section C, T. H. Norton, Cincinnati, O.; Section D, William Kent, New York; Section E, W. J. McGee, Washington, D.C.; Section F, A. J. Cook, Agricultural College, Mich.; Section H, W. H. Holmes, Washington, D.C.; Section I, B. E. Vernon, Washington, D.C.

This ticket was elected as reported from the nominating committee, except that a substitution was made in the Vice-President for Section I, which is notable as the first instance in the history of the Association in which any change was ever made in the list of nominees reported. WM. H. HALE.

CHEMISTRY AT THE BRITISH ASSOCIATION

MANY of the papers read in Section B this year were of considerable theoretical importance. Additional interest was also given to the proceedings by the presence of several distinguished foreign guests.

After the President's Address, Prof. Dunstan read the third Report of the Committee on the present methods of teaching chemistry. During the past year the Committee has been principally engaged in collecting and comparing the regulations issued by the more important of the examining bodies in the kingdom, in order to discover how far their requirements were in harmony with such a course of instruction as that suggested by the Committee in their second Report, presented at the Newcastle-on-Tyne meeting. The Committee direct special attention to the following points:—

It is of great importance that natural science should be sufficiently represented on the board which issues the regulations and is responsible for the proper conduct of the examination.

In addition to examinations, periodical inspection of the teaching seems desirable, the reports of the inspectors as well as the students' own record of work testified to by the teacher being taken into account in awarding prizes, certificates and grants, in addition to the results of an examination.

With respect to the schedules and examination papers, for the most part they do not aim at an educational training of the kind suggested in the Committee's last report, being on the other hand more suitable for those who wish to make a special and detailed study of chemistry as a science. The obvious conclusion is that the necessary reforms can only be brought about by the active co-operation of examiners and teachers.

Sir Henry Roscoe introduced a discussion on recent legislation for facilitating the teaching of science. He drew attention to the powers given by the Technical Instruction Act of 1889, to County Councils and other local authorities, and assured his hearers that the Education Department and the Science and Art Department were extremely anxious to give local authorities a free scope, and free choice of subjects. Referring to the action of the Chancellor of the Exchequer, which placed in the hands of the County Councils this year the sum of £743,000 to be devoted, whole or in part, to the purpose of technical education, he urged upon these bodies the importance of taking full advantage of this grant. In the discussion which followed hopes were expressed that the money would not go simply towards the relief of the rates. It was also remarked that for the success of these provisions it is necessary that more attention should be given to primary education.

Dr. J. H. Gladstone and G. Gladstone read a paper on the refraction and dispersion of fluorbenzene and allied compounds. Fluorine behaves quite differently to chlorine, bromine, and iodine, as it exerts scarcely any refractive action upon the light rays, and it has the property of reversing the dispersion produced by other substances.

Dr. G. H. Bailey and J. C. Cain gave a paper on a method of quantitative analysis by weighing precipitates suspended in liquids. The object of the method is to do away with the operations of filtering and washing. The specific gravity of the precipitate having been determined once for all, it is weighed together with the supernatent liquid in a specially constructed measuring flask. The specific gravity of the supernatent liquid can be readily determined, and hence the weight of the precipitate calculated. The method is found to be rapid, and to give results of sufficient accuracy for many technical purposes.

Dr. G. H. Bailey and A. A. Read gave a paper on the behaviour of different metallic oxides when exposed to high temperatures. This is a continuation of work previously published in the Journ. Chem. Soc. on oxide of copper. The following oxides were subjected to high temperatures in an oxidizing atmosphere:—SnO_2, Bi_2O_3, V_2O_5, PbO WO_3, MoO_3. The following results were obtained:—V_2O_5 was converted into V_2O_3, SnO_2 lost weight slightly, and MoO_3 lost oxygen, and was transformed into the blue oxide of molybdenum, the others were unchanged. It was suggested that some light might be thrown by the experiments on the formation of minerals in nature.

A paper was then read by Dr. G. H. Bailey on the spectrum of the haloid salts of didymium. The influence of dilution and of various reagents on the intensity of the different bands was studied. It was found that the addition of nitric acid to the solution of didymium chloride influenced some bands quite differently to others. Again the variation of the halogen element, in combination with the didymium, brought about differences in the relative positions of the bands. In addition to these, observations were also made on the effect of polarised light. Each of these different conditions influenced the bands sometimes in intensity, sometimes in position, and this in a selective manner. The connection was pointed out between these results and the experiments of Welsbach on the fractionation of didymium.

Prof. Armstrong read the fifth Report of the Committee on isomeric naphthalene derivatives. A complete set of reference compounds has now been prepared in the disubstituted series. It is found that although 13 dichlor naphthalenes have been

described only 10 exist. Of the 14 possible triderivatives 13 are known. Light has been thrown by these researches on the mode of action of reagents upon naphthalene and other hydrocarbons, and it appears that in all cases the initial action is the same, the ultimate product depending on secondary causes, *e.g.*, in the case of benzene an ortho compound is always first obtained, meta and para compounds being produced by secondary causes. The influence of structure on the colouring properties of naphthalene derivatives has also been studied in connection with these researches.

Prof. J. H. Van't Hoff read a paper on the behaviour of copper potassium chloride and its aqueous solutions at different temperatures.

This compound, which is a blue salt, splits up on heating into potassium chloride, water, and a brown double salt, according to the following equation: $CuCl_2\ 2KCl_2H_2O = CuCl_2KCl + KCl + 2H_2O$. On cooling the reverse change takes place. The brown salt can also be formed by the action of cupric chloride on the blue salt thus: $CuCl_2\ 2KCl\ 2H_2O + CuCl_2\ 2H_2O = 2CuCl_2KCl + 4H_2O$. The changes of volume attending these transformations have been studied, also the solubility of the various constituents of the system at different temperatures, and the vapour pressure of their solutions, and interesting relations are shown to exist between the values obtained in each case.

Dr. Richardson read the Report of the Committee for the investigation of the action of light on the hydracids of the halogens in presence of oxygen.

It has been found that the presence of 10 per cent. hydrochloric acid prevents all decomposition of chlorine water, even after long exposure to sunshine.

Aqueous solutions of pure bromine and iodine have been exposed to sunlight for a period of fourteen months. It was found that, in a dilute solution of bromine water (0·16 per cent. Br.), as much as 57 per cent. of the total bromine is converted into hydrogen bromide; in a saturated solution the minimum amount of decomposition occurs, again increasing with further additions of bromine. With iodine water under an atmosphere of carbon dioxide, 8·3 per cent. of the total iodine in the solution was converted into hydrogen iodide. Under an atmosphere of air 14·2 per cent. of the total iodine was converted. Further experiments have been made on the oxidation of gaseous hydrogen bromide in sunlight. The presence of free bromine exercises a retarding influence on the decomposition.

The influence of temperature on the oxidation of hydrogen chloride and bromide has been studied. Rise of temperature appears to retard oxidation in the first case and accelerate it in the second.

Profs. Liveing and Dewar gave a paper on some experiments on the explosion of gases under high pressure. It was found that with increase of pressure the luminosity of the flame steadily increased. When hydrogen was exploded with excess of oxygen, it was found that large quantities of nitrogen peroxide were formed from the nitrogen present as impurity in the oxygen. The water formed contained 3 per cent. of nitric acid. With excess of hydrogen small quantities of ammonia were formed. It was found that, in an atmosphere of carbon dioxide, it was very difficult to maintain the oxy-hydrogen flame if the pressure exceeded two atmospheres. Experiments were also made with ethylene and cyanogen exploded with oxygen.

Prof. H. B. Dixon and J. A. Harker gave a paper on the rates of explosion of hydrogen and chlorine in the dry and wet states. They showed that there was no great difference in the rate, such as they had previously found with carbonic oxide and oxygen mixtures, thus showing that, in the case of hydrogen and chlorine, the aqueous vapour simply acts like any other inert gas, making the rate a little slower.

Dr. G. S. Turpin read a paper on the ignition of explosive gaseous mixtures. The author has commenced a thorough investigation of the conditions affecting the ignition of explosive mixtures of gases, and the present paper gives an account of the results obtained in a series of experiments on the temperatures of ignition of various mixtures of CS_2 vapour with oxygen and other gases. The method used is a modification of Mallard and Chatelier's second method, in which the gases are introduced into a heated and exhausted bulb. The existence of a discontinuity between gradual combustion and ignition proper is found to exist in some cases, while in others there is a perfect gradation from slow combination, attended by a faint glow, to instantaneous combination, attended by a bright flame. The effect of change of pressure on the ignition was examined and found to be somewhat complex.

The Report of the Committee on the properties of solutions was read by Dr. Nicol. The experiments have now been completed on the solubility of a salt in a solution of another salt, of known strength. In general a salt is less soluble in a salt solution than in pure water. An exception is the case of the solubility of KNO_3 in solution of $NaNO_3$.

A joint discussion with Section A on the nature of solution and its connection with osmotic pressure was opened by Prof. Pickering, in a paper on the present position of the hydrate theory of solution. The supporters of the hydrate theory claim that the curved figures, representing the properties of solutions of various strengths, show sudden changes of curvature at certain points, which are the same whatever be the property examined, which correspond to the composition of definite hydrates, and which, therefore, can only be explained by the presence of these hydrates in the solutions; while the supporters of the physical theory, now identified with the supporters of the osmotic pressure theory, claim to have shown that, with weak solutions at any rate, the dissolved substance obeys all the laws which are applicable to gases, and that, therefore, its molecules must be uninfluenced by, and uncombined with, those of the solvent.

With regard to the lowering of the freezing-point of a solvent, the following questions were proposed:—

(1) Is the molecular depression (*i.e.* that produced as calculated for one molecule dissolved in 100 molecules) constant, independent of the nature of the solvent?

(2) Is it independent of the strength of the solution, so long as this strength does not exceed the limits (gas strength) above mentioned? (Boyle's law).

(3) Is it independent of the nature of the dissolved substance? (Avogadro's law).

Evidence was adduced involving a negative answer to each of these questions.

Objection was taken to the theory of dissociation into ions, on the grounds of its irreconcilability with our ideas of the relative stability of various bodies, and with the principle of conservation of energy.

A letter was afterwards read from Prof. Arrhenius in which it was shown that both the osmotic pressure and the electrical dissociation theories must be taken into account in drawing conclusions from observed numbers.

Prof. Armstrong remarked that, according to the electrical dissociation theory, hydrochloric acid and water must be regarded as entirely different substances, whereas in their chemical relations they are very nearly allied.

Prof. Fitzgerald, Prof. Ostwald, and Prof. Lodge all spoke to the effect that Ostwald's experiment, on the decomposing effect of a charged body on a salt solution, does not involve a contradiction of the principle of the conservation of energy.

P. J. Hartog and J. A. Harker described a convenient form of apparatus for determining freezing-points, and for performing reactions in the cold. Adopting a proposal of Raoult, the evaporation of a volatile liquid is used to produce low temperatures.

A paper was given by A. G. Green, C. F. Cross, and E. J. Bevan, on a method of photographic dyeing and printing. It was observed that the diazo-compound of primuline was decomposed by light, thereby losing its property of combining with phenols and amines. If a material, dyed with diazotized primuline, be exposed to light under a design, those parts which are acted upon by light will be decomposed, whilst the parts protected from the light will remain unaltered, and consequently on subsequent development with a phenol or amine, will produce colours, whilst the decomposed portions will not.

Prof. Thorpe gave a demonstration of some of the most striking properties of phosphorous oxide. He believes that the physiological effects usually ascribed to phosphorus are due in reality to this oxide.

Prof. R. Meldola read a paper on diazo-amido-compounds, a study in chemical isomerism. The paper dealt largely with heterogeneous diazo-amides, which the author believes have the general constitutional formula—

$$\begin{array}{l} X{-}N{-}N{-}NR'{-}Y \\ \quad\ |\ \ | \\ Y{-}N{-}N{-}NR'{-}X \end{array}$$

thus being derivatives of a hypothetical tetraimine—

$$\begin{array}{l} HN{-}NH \\ \quad\ |\ \ | \\ HN{-}NH \end{array}.$$

Compounds have been prepared of all degrees of stability, from well-defined individuals to molecular compounds. The above general formula has been given for chemical reasons. A molecular weight corresponding to half that represented by the above formula is given by Raoult's method, but it is believed that dissociation takes place in solution.

C. H. Bothamley read a paper on the action of phosphorus trichloride on organic acids and on water. The equation given in the text-books, representing the action of phosphorus trichloride on organic acids, is shown to be incorrect. An equation given previously by Thorpe is confirmed, viz. :—

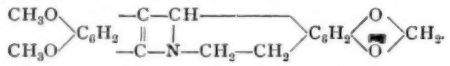
$$3CH_3COOH + 2PCl_3 = 3CH_3COCl + P_2O_3 + 3HCl.$$

The reaction, however, only takes place according to this equation in the case of acids of low molecular weight, and when the reacting substances are present in the required proportions. As the molecular weight of the acid increases the reaction tends to become more complex.

A paper was read by Prof. W. H. Perkin, Jun., on the constitution of the alkaloid berberin. On treatment with permanganate the alkaloid yields three principal oxidation products of the following empirical formulæ :—

$$C_{20}H_{17}NO_8, C_{20}H_{17}NO_7, C_{20}H_{17}NO_6.$$

From the results of the careful investigation of these, the following formula has been proposed for berberin :—



In the course of the meeting interesting discourses were given by Dr. W. H. Perkin on the development of the coal-tar colour industry since 1880, and by Prof. Hummel on fast and fugitive coal-tar colours.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE short but extremely useful address of the President, A. H. Green, Professor of Geology at Oxford, formerly of Mathematics and Geology at the Yorkshire College, dealt with the educational aspect of Geology. Although he dwelt on the risk of becoming loose reasoners, which geologists continually ran, the President pointed out how by a proper training in minute and delicate experimental work, the student might be taught the necessity of exactness, and could then proceed to practical work, which would lead him into the open air, and compel him to acquire the eye and enthusiasm necessary for geological research.

Amongst the reports presented to the section was one by Prof. T. R. Jones, describing a *Saccocaris* from the Arenig, *Aristozoe* and *Estheria* from the Devonian and Carboniferous; one by Mr. G. R. Vine, giving lists of Cretaceous Polyzoa from the Neocomian, Gault, Upper Greensand, Cambridge Greensand, and Red Chalk; one from Mr. A. Bell giving the lists of fossils obtained from the "manure gravels" of Wexford, by which he is able to indicate the date of the final separation of Ireland from England; and one from Mr. Marr, giving the proposed circular letter and record sheet to be issued to the curators of public and private museums, in order to obtain a reliable register of the location of all type specimens of fossils.

Mr. Jeffs presented the report of the Photograph Committee containing a list of about 300 photographs of geological interest, and suggestions for their collection and registration; he also exhibited photographs collected during the present year, amongst which some from Yorkshire, Antrim, and Scotland were of especial value; Dr. H. Johnston-Lavis gave an elaborate report on the volcanic phenomena of Vesuvius, including a plan of the cone in April 1890, an estimate of the lava extruded between May and December, 1889, and a general record of the doings of the volcano in the year; while Mr. De Rance's report on underground water included an immense number of well sections in different parts of England.

The chief papers contributed to the section were perhaps those on local geology, some of which gave the results of many years' research. Mr. Holgate described the coals and clays of Leeds, and showed that the colour and texture of the containing rock was influenced by the nature of its fossils; thus, the more delicate plants like ferns give blue, larger plants black, and animal remains hard, black rocks. He followed with a paper on the physical properties of coals, in which he showed that coals with a dull black colour and a wide cleat were chiefly made of spores, with but little fusible ash, and were the best for use where the temperature is high; while the bright, soft coals, with close cleavage, made largely of mineral charcoal and probably of plant stems, contained much fusible ash, broke up in burning and formed slow burning, caking coals. Mr. J. R. Dakyns described the setting in of the Yoredale beds in Yorkshire, and the gradual changes which occur in them and in the lower and upper Millstone grit as the beds are traced northwards; Messrs. Cash and Lomax accentuated the identity of *Lepidophloios* and *Lepidodendron*, of which plants a magnificent series of slices was displayed in the temporary museum; Mr. J. W. Davis stated that fish remains had been found at nine horizons in the West Riding coal-field, from two of which, one above the Better bed and the other in the Adwalton Cannel of Tingley, no less than sixty species of fish and some of Labyrinthodonts had been described. Mr. Tate identified the so-called "Ingleton Granite" as a quartzose volcanic tuff, and Phillips's dyke at Ingleton as a mica-trap belonging to the minette group; Dr. Hatch also described mica-trap dykes from nine localities in West Yorkshire. Prof. Silvanus Thompson gave the results of experiments on the sources of the river Aire made by means of the fluorescent properties of uranin, and Mr. Maule Cole described a lacustrine deposit of post-glacial age near Filey.

Mr. Lamplugh dealt with the famous cliff section at Speeton, which was in capital condition for the inspection of a geological excursion on Saturday. He divided it into five zones by its belemnites, and by means of this classification was able to correlate its divisions with those of Lincolnshire. The same author gave a table of the Yorkshire boulders, from which he concluded that the North Sea ice stream drove that from the valleys of the Tees and other northern rivers southward and pressed it against the high eastern coast of Yorkshire. In a second paper he argued that the North Sea ice which formed the Basement Clay with its shelly inclusions, overtopped the Speeton cliffs and overrode Flamborough Head, passing into Bridlington Bay; the purple clays of Holderness were the equivalent of gravels of the interior and to the north; whilst the Upper Boulder Clay (and Hessle Clay) was formed by the retirement of extra-British ice and the increase of that from the Pennine high land. Mr. Lamplugh also presented a final list of mammals and shells from the ancient sea beach of Bridlington, which is earlier in date than the first glaciation of the Yorkshire coast. In connection with local glacial work may be mentioned Dr. Crosskey's report on erratic blocks; he exhibited a fine map of the distribution of the principal boulders in the Midlands, gave lists of boulders from Warwickshire, Lancashire, Cheshire, Isle of Man, and Yorkshire, and attributed their deposit to at least two distinct periods; Mr. Kendall's note on the occurrence of Eskdale and Scotch granites and local rocks in the glacial drifts of the Isle of Man; the account of the boulders of Scotch and Cumbrian granites and other rocks from the Cheshire area by Messrs. Antrobus and Hatch; and a paper by Mr. E. Jones describing the find of neolithic burials in the Elbolton cave near Skipton.

Taking the more general papers in order, we come to two papers by Dr. Hicks, one on earth-movements and their effects on Archæan and Lower Palæozoic rocks in Wales and Shropshire, and a second on the contents of Cambrian conglomerates, which provoked some discussion. In the latter he identifies twenty types of fragments, many of which must have been derived from Archæan rocks, while in the former he attributes many phenomena to earth-movement, which have often been put down to intrusion. Mr. Morgan noted the occurrence of Llandovery rocks in Montgomeryshire, and Mr. Watts correlated so far as possible the Silurian rocks of the Long Mountain with those of the typical Silurian areas of Wenlock and Ludlow. An important paper, establishing correlations in the Devonian rocks of South Devon and Cornwall, was read by Mr. Ussher, and one on an unconformity involving the absence of two zones in the Upper Lias of Bridport, by Mr. J. F. Walker. Mr. Whitaker suggested that trials for coal in the south-east of England might well be made in such localities as St. Margaret's, Chartham, Chatham, Bushey, and Coombs, where borings had already given some idea of the thickness and character of the secondary rocks. Mr. G. H. Morton showed that the Liverpool Bunter was 1950 feet in thickness and the Keuper, of which only the lower part is exposed, 800 feet; two important pebble beds

occur in the succession. Mr. A. Irving dealt with the chemical and geological characters of the Bagshot sands, their bedding, and fossils, and argued that they must have been deposited in an estuary opening on the sea.

Chief amongst the palæontological papers must be placed Prof. Marsh's restorations and descriptions of the Ceratopsidæ, of the skulls of which he exhibited life-size diagrams, some more than six feet in length. Prof. Seeley gave a description of the mural arch in the Ichthyosauria from Liassic and Oolitic specimens. Mr. Smith Woodward exhibited five examples and plates of fishes from the Hawkesbury series, and, on behalf of Prof. Anton Fritsch, plates and descriptions of Palæozoic Elasmobranchs, while Dr. P. H. Carpenter, dealing with the morphology of the Cystidea, compared them with the Crinoids and Blastoids, and suggested that in forms without a genital pore the anal pyramid may have subserved generative functions, while in two forms a fourth opening may possibly have been nephridial in function.

With the exception of local papers, petrology was thinly represented. Mr. Hunt read a paper on the saline inclusions of the Dartmoor granite, and favoured the idea of their derivation from the sea; and Mr. Brindley gave a useful account of the principal marbles of the Mediterranean—a pendant to Sir Lambert Playfair's address to the Geographical Section. Other foreign papers were, one on the geology of Nicaragua, and a second on human footprints in recent volcanic mud in the same area, by Dr. J. Crawford, an account of the minerals of New South Wales, including coal, gold, silver, tin, copper, antimony, iron, diamonds, and ornamental stones, by Mr. C. S. Wilkinson, and a paper on the seismic origin of the "Barisál Guns" of the Gangetic delta, by Mr. T. La Touche.

There only remain to be mentioned, Dr. Tempest Anderson's photographs and descriptions of landslips and volcanoes in Iceland; Mr. Logan Lobley's paper containing an estimate of the gold scattered through the pyrites in the clays and chalk of south-east England; Mr. Hart on volcanic paroxysms; and a paper by Mr. Browne on historical evidences for changes of sea and land levels in the south-east of England.

MECHANICS AT THE BRITISH ASSOCIATION.

THERE was a full programme in Section G at the recent meeting of the British Association at Leeds. It is questionable, however, whether quantity was not obtained somewhat at the expense of quality. We are aware of the great difficulty there is in regulating the supply of papers in the Mechanical Section, and so long as the present mode of procedure remains in force the difficulty will also remain. There should be a limit to the number of papers to be read, and there should be a fixed day on which contributions might be sent in. The day being fixed, it should be adhered to with absolute severity—not the names of all the professors and all the science-knights should suffice to break the law. The papers that were deemed most worthy would be accepted, whilst those with less merit would be returned with thanks. This would create a competition amongst contributors, and would-be contributors, which would, we are sure, have a most healthy influence on the proceedings of the Section. We do not make these remarks simply by the way; the fact is, the proceedings in Section G are becoming of a scrambling and hap-hazard character. It is not long since that one gentleman in this Section read a paper he had previously read before the Institution of Naval Architects. He did not take the matter and re-dress it, but calmly read from the proceedings of the latter society, word for word. This year we have had a great deal of matter that has already appeared in some of the technical journals. The discussions on the papers were, as a natural consequence, generally of a poor description. There was so much to get through that the president was obliged to be constantly hurrying, and any one who was not of the elect was treated with somewhat scant ceremony. As no one knew what the papers were to be about, the most that could be said as a rule was of a superficial and commonplace character, some of the most noted exponents of this school of discussion being especially to the fore. It is very certain that, unless Section G sets its house in order, the mechanical science of the British Association will become a byeword amongst engineers. When one contrasts the scant and listless audience at Leeds last week with that at a meeting of the Institution of Civil Engineers, or of the Institution of Naval Architects—the meetings of the latter are more akin to those of the British Association—one cannot but feel that there is need for very radical reform. The two chief reforms we would suggest would be that a limit should be put to the number of contributions, and that abstracts should be printed in good time and copies be previously sent to members and associates on application. The former would raise the quality of the papers—because that which every one can get no one values—whilst the latter would raise the quality of the discussions.

There were thirty items on the five days' programme in Section G, namely twenty-seven papers, two reports of Committees, and the Presidential address of Captain Noble. The proceedings commenced at noon of Thursday the 4th inst., a later hour than usual being selected in order that the members of the mechanical section might hear the Presidential address of Dr. Glaisher in the Mathematical and Physical Section. Captain Noble's address we have already printed in full.

The first paper on the list was by Mr. J. F. Green, of Blackwall, and was entitled "Steam Life-Boats." The historic firm at Blackwall Yard have at last succeeded in solving a problem, oft attempted but never before with success, and have produced a steam life-boat which has given satisfaction to the Royal National Life-boat Institution. The vessel is driven by the reaction of a stream from a turbine, a mode of propulsion which certainly finds a useful position for life-boat work, whatever may be its shortcomings in the matter of mechanical efficiency. The boat has been placed on the Harwich station, and gives, we think, every promise of success. The great question is undoubtedly that of expense, first cost of boat and cost of upkeep. That however is a matter to be settled by Messrs. Green and the Life-boat Institution. We would suggest that this boat might be improved by the use of liquid fuel on the principle adopted by Messrs. Doxford, of Sunderland, and applied by them to the big torpedo boat they have recently constructed. We know the danger of including too many experiments in one vessel, but now that Messrs. Green have proved their design so far they might venture a step further; and we can speak as to the practicability of the liquid fuel system in question.

"The Victoria Torpedo" was the title of the next paper, which was contributed by Mr. G. R. Murphy. This weapon, which, like all other torpedoes, is to beat everything that has gone before in murderous potentiality, has not yet assumed tangible shape, but the form it is to take when completed was fully illustrated and described in the columns of one of our technical contemporaries a few weeks ago. A paper on aluminium bronze, which calls for no special comment, came next, and was followed by one of the most interesting contributions to the section, in the shape of a paper by Prof. Barr and Dr. Stroud, on new telemeters and range finders. Without illustrations we could not give a fair description of the ingenious instruments, in which the authors of the paper have applied certain mathematical laws to judging of distance, and we will therefore leave the subject for a future occasion.

On the following day, Friday, the 5th inst., the proceedings commenced with the reading of two reports of Committees, namely the Estuaries Committee, and the Graphic Methods Committee. Both these were very brief, and consisted in substance in saying that the work was still progressing. A paper on the manufacture of netting from sheet metal dealt with a process already described in a technical journal. A number of short slits are made in a sheet of metal by a special shearing press, and the slits are opened out so as to form a number of diamond-shaped holes. The invention is ingenious, and the "netting" possesses the great merit of rigidity. Cable tramways next occupied the attention of the Section; Mr. W. N. Colam reading a paper in which he described certain devices which he has devised in connection with this means of dealing with passenger traffic. The "Serve" tube and the simplex brake were the subjects of two papers by Mr. W. B. Marshall. The former is for boiler tubes, and has ribs of metal running the whole length of the interior of the tube. These ribs extend down into the stream of hot gases, and so absorb much of the heat that would otherwise go to the uptake. Of course the heating surface of the tube is much increased, and this is effective heating surface, as the resistance to absorption is greatest at the surface. The Thorne Type Composing Machine, which next came before the Section, appeared to us as an old friend which we think made its *début* in Europe at the American Exhibition, if not before, and was duly illustrated and described in the technical journals of the day. The Bénier hot air motor had

also previously made its appearance in an engineering publication, but the contribution of Mr. Vernon on this subject was taken as read.

On Saturday, the 8th inst., only three papers were taken. Prof. A. Lupton read a contribution on the pneumatic distribution of power; in the course of which he gave some interesting details of the important system which is now working at Birmingham. This paper gave rise to a good discussion, in the course of which the author was sharply taken to task for the efficiency he claimed for the system. It should be pointed out, however, that Mr. Lupton did not speak of "efficiency" as looked at from a scientific standpoint, but from a commercial point of view, which enabled him to take credit for certain waste heat, not obtained from the power installation, which would otherwise be thrown away. This was plainly stated in the paper. Mr. F. G. M. Stoney's paper on the construction of sluices for rivers, &c., was next read. The subject was of course well treated by the author, and the paper was acceptable; but there was little novel in it, except the reference to the new tilting sluices which are to be put up in connection with the new lock at Richmond. Mr. Cope Whitehouse's paper on the Raiyan reservoir was listened to by a thin audience, the preparation for the afternoon's excursions calling the majority away.

Monday in Section G is now given over to applied electricity, and there is invariably a large influx of the more abstract A's into the section. The Leeds meeting was no exception to this rule, and when Sir William Thomson opened the proceedings by reading his paper the People's Hall, which the section occupied, had quite a crowded appearance. The subject which first occupied Sir William's attention was the new electric meter which he has recently brought out. This apparatus is yet in the experimental stage. Perhaps Sir William will be able to do something towards cheapening the design. An example of the meter was shown in operation on the platform. In the discussion which followed, Prof. Fleming made some pertinent remarks on the effect of rough and smooth surfaces. The multicellular voltmeter and the engine-room voltmeter described by the author had previously been brought before the public through the medium of technical literature. A new form of voltapile, also described, was an instrument which was intended for standardizing operations. Mr. Gisbert Kapp described the Lineff system of electric traction, by means of which a partially buried conductor can be used with safety to man and beast. Messrs. Lawrence and Harries next read a paper on alternate *v.* continuous currents in relation to the human body. No doubt at times the effect of electrical currents on the human body possesses a very intense interest for engineers, nevertheless the paper was hardly suitable for the Mechanical Section. It is well, however, that engineers should remember, as was stated in the paper, that not voltage only, but current strength is the important factor in estimating the danger from accidental contact. In the discussion which followed, the late American execution naturally occupied a prominent place. Mr. Wilson Hartnell brought the meeting back to a more mechanical complexion by reading a paper on electric lighting and fire insurance rules, illustrating his remarks by practical examples. He succeeded pretty conclusively in showing that the fire insurance companies want instruction in electrical matters, and, we think, at the same time, he surprised some of those present, who certainly have had considerable experience in electrical matters, by the result of his experiments. The paper was eminently practical and worthy of study by engineers. The last paper on the list for the day was by Mr. W. J. S. Barber Starkey on secondary batteries, in which the author described his system of adding carbonate of soda to secondary batteries. The subject is not new.

Tuesday, the 9th inst., was the last day on which Section G met. Mr. Preece first occupied about five minutes in reading a short contribution on submarine cables for long distance telephony. Mr. F. Higgins next exhibited the "Column Printing Machine," after which Mr. Arthur Greenwood read his paper on heavy lathes. Mr. W. Bayley Marshall followed with a suggestive paper on factors of safety, in which he gave the results of a large number of tests of iron and steel extending over a period of five or six years. The conclusion he had come to was that in roof and bridge work elastic limit, and not ultimate tensile strength, should be the important factor, but in the discussion that followed, which was the best discussion during the meeting, the pertinent question was raised as to what "elastic limit" is. A paper by Mr. J. H. Wicksteed on the measurement of elongation in test samples was also well discussed. A paper by Mr. A. Mallock, on the measurement of strains, in which the author described an instrument he had devised for the purpose, and an exhibition by Prof. Barr of a mechanism for giving vertical motion to a camera, brought the business of the Section to a close.

SCIENTIFIC SERIALS.

American Journal of Science, September.—Rocky mountain protaxis and the post-cretaceous mountain-making along its course, by J. D. Dana.—The magneto-optical generation of electricity, by Dr. Sheldon. It is well known that, by using proper conditions, a beam of plane polarized light may be rotated by an electromagnet, and that a reversal of the current causes the plane to be rotated in the opposite direction. A rapidly alternating current thus produces a rapid swinging to and fro of the plane of light. The author has conducted the converse experiment, and by oscillating the plane of polarization through 90° about 300 times per second, has produced an alternating current.—Contributions to mineralogy, No. 49, by F. A. Genth, with crystallographic notes by S. L. Penfield. The results are given of the examination of some specimens of ferric sulphate from Mina de la Compania, Chili.—Chalcopyrite crystals from the French Creek Iron Mines, St. Peter, Chester County, Pa., by S. L. Penfield.—Koninckina and related genera, by Dr. Charles E. Beecher.—The effect of pressure on the electrical conductivity of liquids, by C. Barus. It is shown that, both in the case of mercury and a concentrated solution of zinc sulphate, the effect of isothermal compression is a decrement of resistance nearly proportional to pressure, and from this fact the deduction is made that the immediate effect of rise of temperature is a decrement of specific resistance.—Notice of two new iron meteorites from Hamilton County, Texas, and Puquois, Chili, by Edwin E. Howell. Analyses of the two meteorites are given.—The Cretaceous of Manitoba, by J. B. Tyrrell.—On mordenite, by Louis V. Pirsson.—Geology of Mon Louis Island, Mobile Bay, by Daniel W. Langdon, Jun.—On Leptænisca, a new genus of Brachiopod from the Lower Helderberg group, by Dr. Charles E. Beecher.—North American species of Strophalosia, by the same author.—Notes on the microscopic structure of oolite, with analyses, by Erwin H. Barbour and Joseph Torrey, Jun.

L'Anthropologie, sous la direction de MM. Cartailhac, Hamy, et Topinard, tome i., Nos. 3 and 4 (Paris, 1890).—The exotic races at the Exhibition in Paris, 1889, by MM. Deniker and Laloy. In this report the authors give the general results of the anthropometric determinations they obtained from their examination of 145 individuals belonging to the most different races, some of which had not previously been made the subject of scientific inquiry. The value of their remarks on the various Senegalese and other South African negroes is enhanced by an admirable series of portraits, copied from spirited photographs by Prince Roland Bonaparte. From the observations of the authors, it appears that the negroes of West Africa may be divided into three or four groups, differing in physical characters. In fact, crispness of the hair, and a more or less dark coloration of the skin, seem to be the only characteristics common to all. The negro races generally are tall, have flat noses, and are of a dolichocephalous type, each group presenting, however, certain features which distinguish them from the remainder. The two leading varieties are separated by tribes which are small in stature, with a very hairy skin, and are of a marked brachycephalic type. This intermediate group is spread across Africa from the extreme east to the west, in about 2° S. and 3° N. of the equator, and it is among these peoples that the true pygmy tribes are found, which under the name of Akkas or Tiki-Tiki of the Nile, Batus of the Congo, Akoas of the Ogowe, have become known to us through Stanley and other recent explorers. According to Emin Pasha, to whom we are indebted for the few particulars that we know regarding their physical character, the mean height of these so-called negrilloes is 1·36 m., and their mean cephalic index 79; brachycephalism being a marked character in all the pygmy tribes. Very complete tables are given by the authors.—New explorations at Solutré, by M. A. Arcelin. Palæontologists will welcome the report here given of the various explorations that have been in progress at Solutré since these important deposits were first made the subject of scientific inquiry in 1866. The extent of the beds, which at some points are fully

ten metres in depth, has retarded the work, which is of a complicated nature in consequence of the different groups of materials that have been brought to light, and which include two distinct *foyers*, belonging the one to the reindeer age, and the other to a probably earlier period, besides numerous sepulchral remains and several accumulations of the bones of horses. The latter are perhaps the most curious of the Solutré finds, since within an area of about 4000 metres there is a circular embankment constructed of horse-bones so densely packed that it is estimated to contain the remains of no less than 10,000 animals. According to the author, these bone-mounds may be regarded as the *kökken möddings* of the early men of Solutré, whose principal food must therefore have been horse-flesh.—A note on two Phœnician skulls found in Tunis, by Dr. Bertholon.—Art among the barbarian races at the fall of the Roman Empire, by Baron J. de Baye. The author shows how greatly archæology has gained in recent times by the researches of French and other men of science in regard to art among the barbarian nations. In France the Abbé Cochet, by his clear definitions of the distinctive features of industrial art among races of Burgundian and Frankish origin, has given a new and firm basis to mediæval archæology, and to him we are indebted for several very important works on the forms and symbolical character of barbaric ornamentation, which is now shown to be common to peoples of the most widely separated countries. The present article is copiously illustrated with drawings of buckles and other ornaments presenting symbolical designs, which have been found not only in Central Europe, but in Russia, the Crimea, and Northern Caucasia. From a careful study of these objects, which have ordinarily been referred to as specimens of Gothic art, it would appear that so-called Gothic forms of ornamentation have an eastern origin, and were gradually vulgarized by barbarian tribes in their passage westward.—A history of the so-called Oppidum de Castel-Meur en Cléden (Finistère), by Paul du Chatellier.—The muscles of the face in a negro of Ashantee, by Dr. Popovsky. This case, according to the author, supplies an instance of the interlacing of the facial muscles, which is not unfrequent among the inferior races, and belongs to a class of anomalies presenting a strongly-marked character of atavism.

Bulletin de l'Académie des Sciences de St. Pétersbourg, nouvelle série, vol. i., Nos. 2 and 3.—The chief papers (in French or German) are:—On the normal variations and the perturbations of magnetical declination, by H. Wild.—On some (seven) species of Russian and Siberian earthworms, by N. Kulaguin.—New contributions relative to the *Olenellus mickwitzi* from the Lower Cambrian deposits of Esthonia, by Fr. Schmidt.—On the quantitative determination of antimonium and sodium, by F. Beilstein and O. Blaese.—A formula for the computation of the length of the arcs of longitude upon the earth ellipsoid, by A. Bonsdorff.—The bases of a mathematical theory of the interior diffusion of light, by Dr. O. Chwolson. The general solution of the problem is not possible; but, on the hypothesis that the interior diffusion of light in a transparent body is due to particles of matter which reflect the light, and can be considered as independent sources of light, the author, after having established the general theory, discusses several special cases in which the problem appears simplified to some extent.—Sahidic fragments of the Bible, by O. Lemm.—Fishes from the Lower Silurian deposits, by J. Rohon. The little hooks, described by Pander as "Conodonts," which formerly were taken for teeth of fishes, but are now considered to have belonged to Annelids and *Gephyreæ*, are accompanied by real teeth of Vertebrata which wholly differ from them, and prove that fishes were living at the earliest times of the Silurian epoch as well.—Report of the Russian delegates to the Paris Conference upon Metrical Measures, by H. Wild and O. Backlund.—On the ancient Turkish dialects: (1) Seldschuk verses in the Rebab-Nâmeh, by W. Radloff.—Ad Plutarchi quæ feruntur Moralia, by P. Nikitin.—Devonian fishes from the Yenisei, by J. Rohon, followed by remarks upon the spinal cord of Devonian fishes generally.—De scholiis in Sophoclis tragœdias a P. N. Papageorgio editis, by A. Nauck.—Preliminary results of his observations made upon the satellites of Saturn by means of the 30-inch refractor, by Herm. Struve. The observations were made for the purpose of determining the orbits of the interior satellites, Rhea, Dione, Tethys, Enceladus, and Mimas, and later on, the dimensions of the planet and its rings.

Memoirs of the Odessa Society of Naturalists, vol. xiv.—On the diffusion of a solution of common salt, by N. Umoff. The experiments were made on the system recommended by Sir William Thomson, by means of glass balls, and the results are given day by day for a period of six months. The result is that the law proposed by Dr. Fick for cylindrical vessels is not yet proved.—On the influence of HCl and metallic chlorides upon the photochemical decomposition of water, by E. Klimenko and G. Pekatoros.—On the excretory organs of the Invertebrates, note by A. Kovalevsky.—On isomery in the thiophene series, by N. Zelinsky. Preliminary report.—On M. Timtchenko's anemograph, which combines an anemometer with a weather-cock, by A. Klossovsky.—On some snow-storms, by the same author.—Catalogue of plants found in the neighbourhood of Kishineff (420 dicotyledons and 84 monocotyledons).—On the peritracheal cells of insects, by J. Pekarsky (with a plate).—On the action of the phosphor-pentachloride upon citric acid, by E. Klimenko and Buchstab.—On the snow-covering of South-West Russia, by P. Pantchenko.—On the Nemertinæ of Sebastopol Bay, by J. Lebedinsky. Description of a dozen species of Nemertinæ, formerly unknown at Sebastopol.—Geological exploration in the peninsula of Kertch, by N. Andrussoff. The Mediterranean Miocene deposits of Kertch belong to a basin of the Miocene sea, which extended from Varna, in the Balkan peninsula, to the Ust-Urt, and was connected in the west with the Miocene sea of Roumania and Galicia by means of one or several straits. A good deal of information supplementing the former explorations of the same author is also given.—On the history of the development of the crab *Eryphia spinifrons*, by J. Lebedinsky; an elaborate paper, illustrated by several plates.—On the excretory organs of some insects, spiders, and myriapods, note by A. Kovalevsky.

Bulletin de la Société des Naturalistes de Moscou, 1889, No. 4.—On the chief properties of meteoric showers, by Th. Bredichin (in French). After having developed in his former articles the idea that the "anomalous" tails of comets give rise to meteoric showers, which, as a rule, may appear annually with varying intensities, the author now examines into those meteoric streams which appear in great multitudes at intervals of several years.—Studies on the palæontology of Ungulata, by Marie Pavloff (in French).—The cosmical origin of naphtha, by W. Sokoloff.—Zoological researches in the Trans-Caspian region, by N. Zaroudnoi (in French). The list of mammals mentioned is now increased to 42 species, and that of birds to 309 species; the short notes about their habitats and modes of life are of the same high character as in the preceding work of the same author.

Geological Annals of the Balkan Peninsula, vol. ii., fasc. 1.—Note on the meteorite of Jelica, by J. M. Žujovic. Twelve fragments of this meteorite, which fell on November 19, 1889, were collected; the largest of them weighed 3175 grammes. Its composition resembles that of a trachytic breccia. In an earthy, ash-coloured mass, porphyric elements and angular stony pieces of a dark colour, sometimes 4 centimetres long, are disseminated. The latter seem to be aggregates of crystals, probably of pyroxene. Closer microscopical examination is promised.

SOCIETIES AND ACADEMIES.

SYDNEY.

Royal Society of New South Wales, May 7.—Annual Meeting.—Prof. Liversidge, F.R.S., President, in the chair.—The Report stated that twelve new members had been elected during the year. One honorary member, the Rev. J. E. Tenison-Woods, and one corresponding member, Major-General Sir Edward Ward, R.E., had died, and the total number on the roll on April 30 was 461. During the year the Society held eight meetings, at which the following papers were read:—Annual address, by Sir Alfred Roberts. (1) Note on the composition of two sugar plantation soils; (2) well and river waters of New South Wales, by W. A. Dixon. The aborigines of Australia, by W. T. Wyndham. (1) Note on the recent rainstorm; (2) the source of the underground water in the Western Districts, by H. C. Russell, F.R.S. On the high tides of June 15–17, 1889, by John Tebbutt. List of the marine and fresh-water invertebrate fauna of Port Jackson and the neighbourhood, by T. Whitelegge. The eruptive rocks of New Zealand, by Prof. F. W. Hutton. On the application of prismatic lenses for making normal-sight magnifying spectacles, by P. J. Edmunds. Flying machine memoranda, by L. Hargrave. Irrigation in its relation to the pastoral industry of New South Wales, by H. G. McKinney. (1) The analysis of

prickly pear; (2) on the occurrence of arabin in prickly pear (*Opuntia braziliensis*), by W. M. Hamlet. Personal recollections of the aboriginal tribes once inhabiting the Adelaide Plains of South Australia, by E. Stephens. Aids to the sanitation of unsewered districts (poudrette factories), by J. Ashburton Thompson, M.D. Brux. Notes on Goulburn lime, by E. C. Manfred. Notes on some New South Wales minerals, by C. H. Mingaye. The Australian aborigines, by Rev. J. Mathew. The Medical Section held seven meetings, twelve papers were read, and numerous exhibits shown; the Microscopical Section held six meetings. The Clarke Medal for the year 1890 had been awarded to George Bennett, M.D. Univ. Glas. The Society's Bronze Medal and money prize of £25 had been awarded to J. Whitelegge, Sydney, for list of the marine and fresh-water invertebrate fauna of Port Jackson and neighbourhood; also to Rev. J. Mathew, Coburg, Victoria, for paper on the Australian aborigines; and the Council has since issued the following list of subjects with the offer of the medal and £25 for each of the best researches if of sufficient merit:—To be sent in not later than May 1, 1891: The meteorology of Australia, New Zealand, and Tasmania. Anatomy and life-history of the Echidna and Platypus. The microscopic structure of Australian rocks. To be sent in not later than May 1, 1892: On the iron ore deposits of New South Wales. On the effect which settlement in Australia has produced upon indigenous vegetation, especially the depasturing of sheep and cattle. On the coals and coal-measures of Australia.—The Chairman read the Presidential address, and the officers and Council were elected for the ensuing year, Dr. A. Leibius being President.

PARIS.

Academy of Sciences, September 15.—M. Duchartre in the chair.—On the atomic weight of gadoline, by M. Lecoq de Boisbaudran. The author finds that the atomic weight of gadoline is 155·95, which agrees fairly well with the value 156·75, found previously by M. de Marignac.—Observations of the new minor planet discovered hy M. Charlois, made at Paris Observatory, by M. G. Bigourdan. The nights of observation of position were September 11 and 12.—Observations of Denning's comet (1890, July 23), made with the great equatorial of Bordeaux Observatory, by MM. G. Rayet, Picart, and Courty. Some observations of position are given which extend from August 5 to September 12.—Solar phenomena observed during the first half of 1890, by M. Tacchini. (See Our Astronomical Column).—The shooting-stars of August 9 and 11, 1890, observed in Italy, by M. P. Denza. (See Our Astronomical Column.)—The tornado-cyclone of August 19, 1890, by M. L. Gauthier. The author thinks that the storm of August 19 should be called a tornado-cyclone, because of its complex character. He gives an account of secondary phenomena that accompanied it, viz. electrical manifestations, divisions of the principal branch, the conical form of the cloud, the aspiration produced by the rapid whirling of the air, and the formation of a lateral wind.—The storms of the month of August 1890, and the solar period, by M. Ch. V. Zenger. The author traces a connection between August storms, the Perseid meteors, and the sun-spot period.—On the acetic ester of acetal, by M. A. Combes.—On the *Isonandra Percha* or *Isonandra Gutta*, by M. Serullas. The author gives an account of the *Isonandra Gutta*, both as to its discovery and as to the growth of certain specimens. Some interesting information with respect to the use of gutta-percha for commercial purposes is also given.—Researches on the propagation of the vine by cuttings, by M. L. Ravaz.—Notes were also submitted by MM. Dumoulin-Froment and Doignon on the electrical gyroscope designed by M. Trouvé for the rectification of the compass; and by M. Mathieu Plessy, stating that he had discovered potassium in the supposed new base that he obtained by heating ammonium nitrate (*Comptes rendus*, August 25, 1890).

BRUSSELS.

Academy of Sciences, August 2.—M. Stas in the chair.—On the preservation of oxyhæmoglobin when sheltered from the action of atmospheric germs, by M. Léon Fredericq. In a note published in the *Bulletin de l'Académie*, No. 2, 1890, the author recorded that oxyhæmoglobin may be preserved intact for more than a month without losing its oxygen, and without being transformed into methæmoglobin, by isolating it from the action of atmospheric germs. He has since found that the oxyhæmoglobin cannot be preserved for an unlimited period, but after a time begins to pass into methæmoglobin, and the transformation is complete at the end of a few months. It appears, in fact, that oxyhæmoglobin preserved in a sealed tube and containing atmospheric germs is transformed entirely into reduced hæmoglobin in a few days. If, however, such germs are rigorously excluded, the oxyhæmoglobin is preserved intact for a much longer period, but at length is transformed into methæmoglobin.—On the characteristic property of the common surface of two liquids in contact, by M. G. Van der Mensbrugghe.—On the reduction of invariant functions, by M. Jacques Deruyts.—On conjugate cubical involutions, by M. Cl. Servais.—Some facts with respect to aldehyde, by M. Maurice Delacre. The author brings some facts relating to the dissociation of chloral hydrate to explain why it should be a well-defined and stable compound, whilst aldehyde hydrate is unknown in an isolated state.—On the deformations produced at the surface of a hollow metallic hemisphere by the impact and by the pressure of a hard body, by M. H. Schoentjes.—Reduction of nitrates by sunlight, by M. Émile Laurent. The author has found that a solution of potassium nitrate exposed to the sun behaves as if it contained a nitrite. It has therefore been concluded that the nitrate is reduced to nitrite by the action of sunlight. Griess's reaction was employed for the identification of the nitrites.—On the reduction of nitrates by brewers' yeast and by some Mucorini, by the same author. From a series of researches it has been found that grains of barley and maize sterilized and placed in sterilized water until the shoot was one centimetre long, contain no bacteria in their tissues, and therefore have not the power to reduce nitrates. Hence the author considers the reduction of nitrates as a property common to certain microbes, and to the cells of superior plants which are developed in a medium containing no oxygen. The researches have reference to some observations made previously by M. Jorissen.

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